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ABSTRACT

This hearing was held to review the educational benefits of the U.S. Space Program. Testimony was given by three panels of experts related to this topic. The three panels consisted of: (1) Daniel S. Goldin, Administrator, National Aeronautics and Space Administration (NASA); Dan Brandenstein, Captain, U.S. Navy, NASA Astronaut; and Damon Butler, Student, Summer High School Apprentice Research Program, Oxon Hill High School, Maryland; (2) Wendell G. Mohling, President, National Science Teachers Association; Relzie M. Payton, President, Tennessee Education Association; and Nancy R. McIntyre, Director, Educational Center for Earth Observation Systems, West Chester University, West Chester, Pennsylvania; and (3) Eva Rousseau, Principal, Dunbar Senior High School, Washington, D.C., and two of her students, John Haskins, Jr., and Nadir Al-Salam. These witnesses discussed the benefits of NASA sponsored activities such as the Summer High School Apprentice Research Program, the Teaching from Space program, NASA Field Centers, The NASA Educational Affairs Division, the Tennessee Space Week, a space laboratory called the USS Dunbar Program, and volunteer efforts by the NASA workforce. Copies of prepared statements by the witnesses are included. (MDH)

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U.S. SPACE PROGRAM BENEFITS TO EDUCATION

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED SECOND CONGRESS

SECOND SESSION

JUNE 10, 1992

[No. 140]

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WITNESSES

U.S. SPACE PROGRAM BENEFITS TO EDUCATION

WEDNESDAY, JUNE 10, 1992

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 1:30 p.m. in room 2325, Rayburn House Office Building, Hon. Ralph Hall [chairman of the subcommittee] presiding.

Mr. HALL. The committee will come to order.

The Space Subcommittee is of course pleased to hold this hearing to review the educational benefits of the U.S. space program. In today's very difficult budgetary climate, and particularly with a lot of bills that are up for votes this week and next week, with peoples' minds on the budgetary process, I think it's very important to review each Government program to ensure coordination to meet the Nation's goals, and that's really our purpose.

We have a number of challenges, such as providing better health care, improving the economy and providing our young people with quality education, and of course promoting excellence in education is an old, worn-out phrase, but it still is a very needed goal, and it is a key challenge for the U.S., and it is very critical to the competitiveness of this country.

Since the launch of Sputnik in 1957, which really propelled our Nation into improved math and science education, or at least the pursuit of it, the U.S. space program has been cited often as contributing to the numbers of science and engineering degrees that were awarded and sought after in this country. Besides sparking interest in our young people, the space program also provides us with new keys to understanding life sciences, our planet, and the universe.

A great challenge that faces our Nation today is searching for cures for life-threatening diseases. That would be a product that space could yield to the American people, at a time when the American people are looking for a product, and looking for something other than ticker tape parades, which are in order, and giant expenditures of money, which are necessary.

This program and the testimony today can spawn, I think, maybe the key that we have been looking for to bring this product out of space, that the American people could feel, could see, and could know that it was being useful and worthwhile.

A great challenge faces our Nation today in searching for these, and outer space of course will provide us a unique laboratory to expand our knowledge, and through experimentation on the shut-

tle and ultimately on Space Station Freedom, the breakthroughs in science and medicine might improve the quality of life here on earth immeasurably.

We say it might, because we can't give assurances that it's absolutely going to, but we have every reason in the world to believe that it will. It's a matter of fact that we have not found a cure for these diseases here on earth, and we need another area and another laboratory for those skilled and trained and caring minds to do their programs.

So the intent of this meeting is to examine the role of the U.S. space program and stimulating achievement in math and science education. Our testimony today will begin with Mr. Daniel Goldin, who is the NASA Administrator. He has navigated every other appearance that he has had, including a confirmation appearance, and this is his first appearance since his confirmation hearing.

We are very pleased to also welcome Captain Brandenstein, who was Commander of the Space Shuttle Endeavour's recent mission. I think certainly the Captain should be complimented. He was tops in all the polls. He really should be in politics, because he maneuvered it to where he—well, if Sensenbrenner ever decides to quit, he should be in politics.

[Laughter.]

Mr. HALL. Because he maneuvered it to where his delivery was in prime time. I thought that was well done.

And really, people had their breath held for you and their prayers out for you, and their interest in it. It was a great scene, and great for our program, and great for NASA. We will also have Mr. Damon Butler, who is a student at Oxon Hill High School, and a participant in NASA's summer apprentice research program. We are looking forward to hearing from him.

Our second panel will be comprised of distinguished educators: Mr. Wendell Mohling of the National Science Teachers Association; Ms. Relzie Payton, of the Tennessee Education Association; Mrs. Nancy McIntyre, of West Chester University. These are all educators who utilize the space environment in teaching math and science.

We will have representatives from the Dunbar Senior High School join us for the third panel of this hearing. We will have Dr. Eva Rousseau, the principal, along with Mr. John Haskins and Mr. Nadir Al-Salam, students, who will present the innovative educational program developed at Dunbar High School. We are anxious to hear about that. That is here in Washington. The Honorable Eleanor Holmes-Norton of the District of Columbia, the Delegate, will do the introductory remarks there. We will recognize her at the proper time.

Before we start our hearing, I would like to note for the record that many organizations and industries have outstanding educational activities utilizing the space environment. We couldn't accommodate all of these at this time, we would like to have, and any of them would have been a great addition. We will be accepting written testimony, and it will go into the record, and it will be the same as the testimony that these three gentlemen and the other two panels will be giving.

The Challenger Center, for example, is committed to capturing young peoples' natural fascination with space and sponsors a project, Marsville, the Cosmic Village, where students learn more about their environment by using a Martian habitat. Another organization, the U.S. Space Camp, that we are all very familiar with, is committed to educating and exposing young people and adults to the wonders of space.

Outer space is universally recognized as a magnet for learning and many educational programs utilize the space environment to stimulate students' interest in math and science. In fighting hard each year to preserve funding for NASA's programs, it is important for us to remember that the space program also serves an important role in captivating the interest of our young people—and that's what it's all about — and stimulating their pursuit of studies in math and science. That's really the purpose of our meeting here today.

This concludes my statement, and I would like to call upon Mr. Sensenbrenner to make any statement he would like to make.

[The prepared statement of Mr. Hall follows:]

OPENING STATEMENT
BY RALPH M. HALL

The Space Subcommittee is pleased to hold this hearing to review the Educational Benefits of the U.S. Space Program. In today's difficult budgetary climate, it is important to review each government program to ensure coordination in meeting the Nation's goals. We have a number of challenges such as providing better health care, improving the economy, and providing our young people with quality education. Promoting excellence in education is a key challenge for the U.S. and is critical to the competitiveness of our country. Since the launch of Sputnik in 1957 which propelled our Nation into improved math and science education, the U.S. space program has been cited often as contributing to the numbers of science and engineering degrees awarded in this country.

Besides sparking interest in our young people, the space program also provides us with new keys to understanding life sciences, our planet, and the universe. A great challenge facing our Nation today is searching for cures of life-threatening diseases. Outer space provides a unique laboratory to expand our knowledge and, through experimentation on the Shuttle and ultimately on Space Station Freedom, the breakthroughs in science and medicine may improve the quality of life here on Earth immeasurably.

The intent of this hearing is examine the role of the U.S. space program in stimulating achievement in math and science education. Our testimony today will begin with Mr. Daniel Goldin, NASA Administrator, in his first appearance since his confirmation hearings. We

are pleased to welcome Captain Daniel Brandenstein, Commander of the Space Shuttle Endeavor's recent mission, who will accompany Mr. Goldin as well as Mr. Damon Butler, a graduating student of Oxen Hill High School in Maryland and participant in NASA's Summer High School Apprentice Research Program.

Our second panel will be comprised of distinguished educators. Mr. Wendell Mohling of the National Science Teachers Association, Ms. Relzie Payton of the Tennessee Education Association, and Mrs. Nancy McIntyre of West Chester University are all educators who utilize the space environment in teaching math and science.

We are pleased to have representatives from the Dunbar Senior High School join us for the third panel of this hearing. Dr. Eva Rousseau, the principal, along with Mr. John Haskins and Mr. Nadir Al-Salam, students, will present the innovative educational program developed at Dunbar Senior High School, right here in Washington, D.C. They will be introduced by our colleague, Representative Eleanor Holmes Norton, District of Columbia Delegate.

Before we begin our hearing, I would like to note for the record that many organizations and industries have outstanding educational activities utilizing the space environment. While we could not accommodate all these programs at this time, we will be accepting written testimony. The Challenger Center for example is committed to capturing young people's natural fascination with space and sponsors a project "Marsville: The Cosmic Village" where students learn more about their environment by using a Martian habitat. Another organization, the U.S. Space Camp is committed to educating and exposing young people

and adults to the wonders of space.

Outer space is universally recognized as a magnet for learning and many educational programs utilize the space environment to stimulate students' interest in math and science. In fighting hard each year to preserve funding for NASA's programs, it is important for us to remember that the space program serves an important role in captivating the interest of our young people and stimulating pursuit of studies in math and science.

This concludes my statement. I would like to call upon members of the Subcommittee at this time to make any brief remarks.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

First of all, let me say that I welcome this hearing. It shows very concretely what the American taxpayer gets out of the space program. This is just the tip of the iceberg, because we can talk about telecommunications, we can talk about medical science, research and applications, we can talk about all kinds of things that make our lives simpler and of a higher quality, and perhaps even cheaper to live, that have been spin-offs from the space program since 1957.

When I go around talking to high schools in my district, very frequently I am asked by students "Where is America going in the space program? We want to see American continue its investment in the space program, because those will provide the engineering and math and science opportunities for us when we get out of school."

They are absolutely right. The space program has been one of the engines that has driven us to technical excellence in the world around us, as well as the spin-offs making American-made products competitive around the world in both domestic and international markets. So keeping up the motivation of our high school and college students, their morale and their interest in math and science education, is something that is vital if America is to maintain its technical preeminence during the 21st century.

The space program is one of the things that does that. And if we should neglect the space program, we are going to see fewer and fewer students go into math and science, and we are going to pay the price for that, maybe not next year, but in the decades ahead.

I am particularly happy to welcome Captain Brandenstein, the Commander of the Endeavour, here today. As I informed my chairman when he was suggesting that Captain Brandenstein get into politics, he grew up in the Ninth District of Wisconsin, and we are very proud of his achievements that he had made as a member of the astronaut corps, capped most recently with the great space rescue of the Intelsat satellite that we all saw on prime time. Wisconsin is proud of you, Dan, and we are proud that you are here.

We are trying to get more people interested in math, science and engineering degrees, so that not only the astronauts to come will be motivated, but the engineers and the scientists that put together the hardware and the research projects will be there to continue the tremendous spin-offs that we have gotten from America's investment in space over the last 40 years.

Thank you.

Mr. HALL. We at this time will recognize the gentleman from Texas, Mr. Smith.

Mr. SMITH. Thank you, Mr. Chairman.

As I mentioned a minute ago, I am not going to be able to stay as long as I would like at this hearing because of another commitment at 2:00 o'clock. But I appreciate very much the opportunity to be here for a few minutes, and want to thank the panelists for being here as well.

The space program benefits American in many ways, but perhaps the most important benefit is how space stimulates the desire to learn. Funding alone will never cure America's educational problems. Students must also have a thirst for knowledge. Space

exploration whets that thirst and stimulates students' interest in math and science especially.

Most pre-teen children are fascinated by space exploration. They dream of one day becoming the first man or woman to set foot on Mars. But in high school this fascination often wanes and many students lose interest in math and science. To compete internationally in the coming years, America must produce the scientists and engineers to develop the new industries of tomorrow.

During the years of Apollo, America produced record numbers of science and engineering Ph.D.s. Students believed that space was a growing industry and that opportunities were abundant. It is time again for the United States to commit itself to an aggressive space agenda and to provide the means to capture the imagination and the long-term commitment of students who will pursue engineering and science careers.

Thank you, Mr. Chairman.

Mr. HALL. Thank you, Mr. Smith.

At this time, I recognize the gentleman who represents the Marshall Space Station area, and represents it very well, was a great host for this subcommittee there some time back, Mr. Cramer.

Mr. CRAMER. Thank you, Mr. Chairman.

I applaud this hearing, and the panel of participants in the hearing. I don't think we can do enough to explore the educational benefits that the space program offers to our young people, particular since we are engaged in what seems like an eternal debate over the space program. I think it's only appropriate that we emphasize these issues.

I have the luxury, as the Chairman indicated, of being able to see in my district the fine work of the U.S. Space Camp there, and get to see the many thousands of young people who come from all over the United States and participate there, and get turned on by what they are able to participate in there.

As I speak, we have 1,100 students that are in the U.S. Space Camp either there in Huntsville or at Titusville, Florida. So I would like to see that wonderful and outstanding beginning be built on, and let's explore what else we can do together. We also have a Challenger Center, one of the Challenger Center school programs that we are building in our district. And again, I don't think we can make enough commitment to the young people, and expose them to the opportunities that the space program offers to them.

So Mr. Chairman, I applaud this hearing, and am pleased to be a part of it. I would like to submit a further statement from Ed Buckbee from the U.S. Space Camp for the record.

[The prepared statement of Mr. Cramer follows:]

OPENING STATEMENT OF BUD CRAMER
June 9, 1992

Mr. Chairman - I want to thank you for holding this very important and timely hearing. Exploring the benefits to education provided by our space program could not come at a better time, as we will shortly once again debate the future of Space Station Freedom.

I am looking forward particularly to the testimony of the students that are a part of today's panels. Their insight into the stimulation provided by the space program is very valuable.

Mr. Chairman, I would also like to bring to your attention the testimony that has been submitted by Mr. Ed Buckbee, the Director of U.S. SPACE CAMP. Space Camp is one of the most exciting programs for young people that I have seen. It provides the opportunity for children, teenagers, and adults to experience a space shuttle mission and all of the excitement that accompanies space exploration.

Space Camp is the vision of the late Werner von Braun, who in the early 1970's recognized the need for a science oriented camp for young people. That vision has grown to a program that has reached 128,000 campers since it opened in Huntsville, Alabama in 1981.

As we hear testimony today, over 1,100 students from 43 states are attending U.S. Space Camp programs in Huntsville and Titusville, Florida.

The programs are not only a fun activity. Lectures from aerospace professionals and written coursework add to the insight and motivation provided to the trainees. The Space Camp curriculum is correlated with the standards established by the National Science Teachers Association and some students receive school credit for their participation.

A recent survey of Space Camp graduates highlights the impact of this program on these students. Some of the results are

remarkable. After attending Space Camp, 87% took more science courses, primarily in aerospace and engineering. Almost 80% reported that Space Camp inspired them to take more math. Over 75% of the trainees indicated that they learned about career options while at Space Camp and almost half made a career decision based on their participation.

I would also like to mention testimony that is being submitted by the Challenger Center. Challenger Center was established by the Challenger astronaut's families following the accident.

The Center helps communities establish Challenger Learning Centers which use space exploration and its applications to inspire young people. The programs focus on middle school age children and enable them to apply science and math concepts to real-life situations and problems.

Clearly educational programs such as these based on the space program have a positive impact on our young people. I am

a strong supporter of science related education programs and will continue to speak out on the benefits of the space program to the education of our young people.

Thank you Mr. Chairman.

Mr. HALL. Without objection, the prepared statement of Mr. Buckbee will appear in the record.

[The prepared statement of Mr. Buckbee follows:]

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IMPACT OF THE SPACE PROGRAM ON EDUCATION

Statement by Edward O. Buckbee
Founder, Director, U. S. Space Camp
June 10, 1992

I am pleased to submit a statement to the Space Subcommittee Hearing of the Committee on Science, Space and Technology regarding the Impact of Space Exploration on Education in the U. S.

As founder and director of U.S. SPACE CAMP, I assure you this is a subject of the highest priority and one I devote a considerable amount of time and energy to every day. I've never once accepted the Doomsday Theory that America can't compete on an international level in math and science. The key is education through stimulation, with exploration and discovery being the best stimulants for the young mind.

As early as 1974, when the late Wernher von Braun first mentioned to me the need for a science camp for young people, it has been my belief that the space program's achievements in exploration and discovery could be the focal point in capturing the attention and indeed the imagination of America's youth. Why is the space program such an attraction to them? To put it simply, space exploration is the most challenging field of work that is attainable in the mind of a 12-year-old youngster in America today. To the younger generation, the space program is seen as something at its highest level, an effort by the achievers in this country who set bold and difficult technical goals and achieved them. It's a program that

carries out its work in the open, for all to observe and either approve or disapprove. It's a program that exemplifies cooperation with other nations in the global, peaceful exploration of space. That's why, in my opinion, the space program attracts smart kids and those who want to be achievers. Why is the space program and SPACE CAMP a collective "turn on" for kids who want to be achievers? Here are some comments from some of our SPACE CAMP graduates:

"As a result of SPACE CAMP, I took...Space Technology. I am now, as a result of SPACE CAMP, applying for a position in NASA's SHARP program." -- Stephen Clardy, Huntsville, Ala.

"These space programs have provided an incentive to excel for the sole purpose of someday becoming involved with space exploration. With overflowing happiness, I also am proud to announce my appointment to the Air Force Academy, which certainly would not have been possible had I never experienced the challenges of SPACE CAMP and ACADEMY. I am living and fulfilling my childhood dream!"
-- Jennifer Trost, Mabelvale, Ark.

"I have been motivated to do better in school and at this time I am getting A's and B's instead of C's and D's. The SPACE ACADEMY Level II helped me get my grades back together and I think it can do the same for others." -- Patrick Davis, Renton, Wash.

Since 1981, I have seen 125,000 boys and girls graduate from SPACE CAMP. They come from every state in the union....all walks of life.... all ethnic groups....every size and description....from small towns to big cities, and almost as many girls as boys. They come to touch the space program and learn. They come to be challenged, to learn how to be an achiever and how to be the best at what they want to do. We have a saying in SPACE CAMP, "America's reach should exceed its grasp and you can make it happen by starting now."

The mission of SPACE CAMP, a non-profit, self-sustaining educational organization, is to use the excitement of the space program to motivate students to excel in science and math studies - the foundation of a high tech career. SPACE CAMP offers a new traditional approach to learning with its "hands-on" space tech curriculum. We teach leadership, decision making, self-confidence, teamwork, and problem solving to youngsters just starting in their teens. We use the space program as the example of why you must excel in science and math to be a problem solver and to be a contributor in the 21st century. Examples of this have been proven time and time again by the men and women who work in our nation's space program. They are the role models for our students because they have demonstrated by their actions, not merely words, what hard work and dedication can do for your own self-satisfaction and the country's benefit.

And, I might point out, that we have the support of both former and current astronauts. Members of the original Mercury Seven

Astronauts not only serve as a source of direction and inspiration, but also visit our programs and share their knowledge and experiences with the students. Three-time shuttle astronaut Mike Mullane is serving as a "master teacher" at SPACE CAMP this summer. Mike has stated that he has no doubt that many of our scientists and engineers will someday be able to trace the genesis of their interest in science and engineering to their time at SPACE CAMP.

Today, young people have to be challenged by something that is real and attainable. Space exploration is the carrot in our classroom. It has worked for 10 years with 125,000 graduates and I believe it will continue to work in the coming decade.

Education, through exploration and discovery, is the best stimulant for the young mind. At SPACE CAMP, we give students a glimpse of the future and then challenge them to study and strive to do their very best to be a part of it. Many who come to SPACE CAMP test their dreams and walk away with a career focus, and the inspiration to excel.

Our graduates say it best:

"SPACE ACADEMY gave me a chance to lead, and to follow; that's why I put it on my application to West Point. I really feel like it gave me an edge, both now, in college, and later on." -- Cadet Corporal Dan Robinson, U.S. Military Academy at West Point, N.Y.

"As for my career, I have to say that SPACE CAMP had a very definite impact. In 1991 I received by B.S. in Physics from Virginia Polytechnic Institute." -- Jon Davis, Annadale, VA

"SPACE CAMP initiated my interest in technology." -- Ursula Leubner, Rochester, N.Y.

"I began to take math much more seriously as a result of SPACE CAMP." Patricia Gossett, Birmingham, Ala.

The youth of America is our most valued resource. To develop that resource properly today, we must be creative. We must nourish that resource, develop new teaching techniques, find new role models and challenge them by opening up their minds with bold and exciting ideas. Yes, we must cultivate them, allow them to develop, and then accelerate that growth and development.

I see it happen everyday in Space Camp. We take a shy, little 11-year-old guy and we train him to master special skills that he never dreamed of learning. Soon, he comes together with his teammates and performs his duties successfully, along with others, which enables the team to accomplish their mission successfully.

The space program has fostered many unique products, management techniques and even new industries. Today, in Huntsville, Alabama,

and on the space coast, in Florida, our programs attract thousands of young Americans who come each year to touch the stars and get a glimpse of their future. I'm proud of the young boys and girls I see in SPACE CAMP. They are bright, intelligent, motivated young people who want to make their mark in our 21st century. I'm confident they will not only succeed, but excel in their chosen fields.

In the interest of keeping track of our graduates and their successes, we recently completed a survey on the impact of SPACE CAMP on graduates between 1982 and 1986. I believe the survey results are rather amazing.

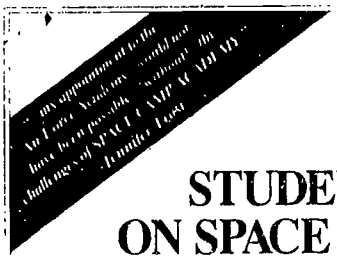
- After attending SPACE CAMP, 87 percent took more science courses, primarily in aerospace and engineering.

- Eighty percent reported that SPACE CAMP inspired them to take more math, specifically calculus and algebra.

- Although the students surveyed attended at a young age, 41 percent reported that their experience at SPACE CAMP was a key element in their choice of curriculum; 87 percent chose engineering, math or science as their course of study.

- During their SPACE CAMP experience, over 75 percent of the trainees polled indicated that they learned about career options while here; almost half made a career decision based on their CAMP participation.

Can America's space program contribute to education? It already has and will continue to do so as long as a young boy or girl can dream of one day being a space engineer, a chemist who studies on other planets, a surgeon who operates in micro-gravity, an architect who designs space platforms, or just maybe....the next Chuck Yeager, Alan Shepard, Neil Armstrong or Sally Ride! SPACE CAMP keeps that dream alive.



STUDENTS REPORT ON SPACE CAMP IMPACT

Since 1982, 120,000 students from all across the United States have attended U.S. SPACE CAMP and U.S. SPACE ACADEMY programs.

The mission of SPACE CAMP, a non-profit, educational organization, is to use the excitement of the space program to motivate students to excel in science and math studies—the foundation of a high technology career. SPACE CAMP takes a non-traditional approach to learning with its hands-on space technology curriculum.

U.S. SPACE CAMP Director Edward O. Buckbee says, "Education through exploration and discovery is the best stimulant for the young mind. At SPACE CAMP, we give students a glimpse of the future, and then challenge them to study and strive to do their very best to be a part of it." Many who come to SPACE CAMP test their dreams and walk away with a career focus and the inspiration to excel.

> *"...SPACE CAMP/ACADEMY had a tremendous impact on my life ...it proved to me that dreams can come true - a career in the space program is a goal that I, or anyone else can achieve."*
> *-Cadet Corporal Dan Robinson*
> *WEST POINT*

A 1992 SPACE CAMP Alumni Survey indicates that young people do enjoy science and math, when the subjects are presented in a hands-on motivational environment. SPACE CAMP showcases learning at its best...and the effects are life changing.

> *"SPACE CAMP played a big part in molding me into a complete person."*
> *-Nathan Heyedus*
> *Philadelphia, PA*

SOURCE: U.S. SPACE CAMP/ACADEMY Alumni Survey (1992) of college students and graduates who attended between 1982-1986 (twelve percent return rate). Compilation by Education Division of U.S. SPACE CAMP/ACADEMY, U.S. SPACE & ROCKET CENTER, Huntsville, Alabama.

STUDENTS REPORT ON SPACE CAMP IMPACT

• After attending SPACE CAMP, 87% took more science courses, primarily in aerospace and engineering.

> *"As a result of SPACE CAMP, I took Space Technology. I am now, as a result of SPACE CAMP, applying for a position in NASA's SHARP program."*
> *-Stephen Clardy*
> *Huntsville, AL*

• Eighty percent reported that SPACE CAMP inspired them to take more math, specifically calculus and algebra.

> *"I began to take math much more seriously as a result of SPACE CAMP..."*
> *-Patricia Gossett*
> *Birmingham, AL*

• Although the students surveyed attended at a young age, 41% reported that their experience at SPACE CAMP was a key element in their choice of curriculum; 87% chose engineering, math or science as their course of study.

> *"SPACE CAMP initiated my interest in technology."*
> *-Ursula Leubner*
> *Rochester, NY*

• During their SPACE CAMP experience, over 75% of the trainees polled indicated that they learned about career options while here; almost half made a career decision based on their CAMP participation.

> *"Before I attended SPACE CAMP, I thought I wanted to be a pilot in the Air Force and then continue to be an astronaut. Upon completing SPACE CAMP, I knew that this is what I wanted, and I wasn't going to let anything stop me."*
> *-Chris Mackey*
> *Waynesboro, MS*

> *"As for my career, I have to say that SPACE CAMP had a very definite impact. In 1991 I received my B.S. in Physics from Virginia Polytechnic Institute."*
> *-Jon Davis*
> *Annadale, VA*

SOURCE: U.S. SPACE CAMP/ACADEMY Alumni Survey (1992) of college students and graduates who attended between 1982-1986 (twelve percent return rate). Compilation by Education Division of U.S. SPACE CAMP/ACADEMY, U.S. SPACE & ROCKET CENTER, Huntsville, Alabama.

Mr. HALL. Now we will have Mr. Bacchus, who is the member of Congress representing Kennedy Space Center. We recognize you for any opening statements you want to make at this time.

Mr. BACCHUS. Thank you, Mr. Chairman.

It's my very strong belief that the educational benefits of the space program simply cannot be overstated. They are so obvious everywhere around us, they almost go without comment. Yet it is important for us to comment on those benefits, because at this point the space program is being challenged in a very difficult budgetary climate.

I want to commend our new Administrator and all in attendance here today for their strong efforts to emphasize the educational aspects of NASA as was envisioned originally when the program was created. First-hand I have seen evidence of that. In April, State Education Commissioner Betty Castor of Florida and I hosted a math and science education forum in Bevard County, where the Kennedy Space Center is located.

This forum was for elementary and secondary teachers, their parents and business community leaders. More than 400 people attended this half-day forum. Among others, NASA headquarters, the National Science Foundation, the U.S. Department of Energy and the Department of Education came to present their Federal initiatives. I would like to personally commend NASA for the participation in that effort, Mr. Frank Olin and Mr. Raymond Corey of NASA. They did a fine job in representing NASA and working closely with the young people and teachers involved.

Of course, I would like also to say a special word of thanks to Captain Dan Brandenstein, who has shown us recently first-hand the educational benefits of the space program for the entire world.

Thank you, Mr. Chairman.

Mr. HALL. While we are pitching out accolades to Captain Brandenstein, among his many other duties and things he needs to do, he took his Saturday morning to come back down to the office, so to speak, in Houston, to accommodate this subcommittee. We also thank you for that. We know when you go way above and beyond, and we appreciate it.

Now if you are really not going to run against Sensenbrenner, I will say some nice things about you.

[Laughter.]

Mr. HALL. All right. We have Ron Packard from California, a very valuable member of this committee, a loyal member and a hard working member of this committee. I recognize him at this time for any opening statement he might want to make. No statement?

Okay, then we can get underway and do that that you are here for. At this time, Mr. Goldin, however you three want to arrange your testimony, we recognize you. You can either summarize, and if you have a written statement you would like to submit for the record, it will be submitted as is. Since you are the head man, you can do it almost any way you want to. We recognize you at this time, Mr. Goldin.

STATEMENT OF DANIEL S. GOLDIN, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. GOLDIN. I think we will do it one, two three.

Mr. HALL. Going to save the best for the last?

Mr. GOLDIN. Best for last. You've got it. The young people in this country are the best.

Mr. Chairman, it's a real honor for me to appear before the subcommittee today to testify on this important national issue, the role and responsibility of NASA in improving the scientific and technical literacy of America's children.

I should note that today is my first official appearance before the U.S. Congress, as you noted before, as the Administrator of NASA, and that it is no accident. When I heard of the subcommittee's interest in this topic, I asked to testify. I wanted this to be my first hearing, because I wanted to let the world know what NASA is doing in this important arena.

As someone who came from a family of educators, including my father and sisters, I have always felt a civic responsibility to promote and foster educational activities. This has been true of my personal life as well as my professional life, and this is a commitment that I bring to NASA. I believe that NASA has a unique ability to capture the attention of our Nation's youth, all of our youth, and I believe that NASA can use its programs and educational resources to offer hope and promise to these young people.

Let me give you a personal experience related to the Endeavour's mission that highlights this factor. My sister teaches in P.S. 76 in New York City. She had her class watch Captain Brandenstein and his noble crew as they were performing their mission. She never told them that I was the NASA Administrator, to stimulate their interest. She just wanted to stimulate their ability in learning, because it's a Chapter One school, and she is trying to improve their reading abilities.

Well, they watched the crew. They watched the crew try and fail, they watched them try and fail, they watched them regroup, and then they watched them try and succeed. And that message came across loud and clear to those young people, that it's okay in life to have some failures, because you can lift yourself up, dust yourself off and move on. My sister told me that the learning experience in that classroom was much improved after they watched this valiant crew. That's what the program is all about.

So I am honored to share this witness table today with Captain Brandenstein and Damon Butler. Dan, Damon and Dan are here to offer you a 3-D view of the educational role of the space program. Dan Brandenstein recently returned from commanding the maiden voyage of Space Shuttle Endeavour. That mission was successful for not only capturing the wayward Intelsat satellite, but also for capturing the excitement and imagination of all Americans, especially the school children.

I should note that Congressman Tom Lewis of this committee was the father of Name the Orbiter competition, and the school kids from Georgia and Mississippi who won the competition and were at the Endeavour launch showed the value of this initiative. While I was down there, I met a young man who was all fired up

for space. He was from the Trinity School in your district, Congressman Bacchus. I want to read this letter, because it was just really exciting.

"Dear Mr. Goldin, Thank you for inviting myself and my classmates to the launch, especially in the V.I.P. section. While I very much enjoyed seeing my first launch at the Cape, it makes me feel even better because it is Endeavour's first flight. I am an 11 year old young, Black and gifted person who enjoys reading, sports, and a little math and science on the side.

"Thanks again, gratefully, Kwami James."

I met this young man, and he was just full of excitement. And that excitement stemmed from his experience in the space program.

I am also joined by Damon Butler, a NASA student research apprentice, who just graduated from Oxon Hill High School and plans to attend North Carolina State University and major in engineering. I should note that this is Damon's second appearance before Congress, so he has given me some pointers.

As President Bush noted in a speech at Texas A&I, our space program will help rekindle public interest in science and mathematics, and revitalize an area of our educational system that has become disturbingly weak. And President Bush was right. We do have an opportunity to improve science, mathematics, and technology education in America's schools, and to make the U.S first in math and science by the year 2000. The men and women at NASA are seizing that opportunity. We are committed to supporting that vision.

Since the inception of the space program, NASA and the Nation's education system have travelled parallel paths. We share the same goals—exploration, discovery, the pursuit of new knowledge—and the achievement of those goals is interdependent. NASA depends on the education system to produce a skilled and knowledgeable work force.

The education community, in turn, uses the space program to motivate and encourage students to study science, engineering and technology. If the United States is to remain at the forefront of space science and aerospace technology and research, then we must provide students with the skills they will need in a highly complex and technical workplace.

We must also push the cutting edge of technology and develop world class facilities so they have the resources to compete in the global marketplace of tomorrow. NASA recognizes that the next generation of science, research and technology can only be as good as the nest generation of scientists, engineers, technicians and teachers.

If NASA is to continue to attract the best and the brightest, as we have over the decades, while at the same time helping to ensure a more technically literate society in the future, our educational outreach program must target the entire educational pipeline, from kindergarten all the way through post-doctoral work.

To date, the agency has done a good job in the area, but in the future, we must reach out even more to make sure that all Americans—and I emphasize all Americans—have access to our programs and an opportunity to reach the stars. As Dr. Allen Keyes of

Alabama A&M recently said, "People forget what may be the most pressing need of all, the need for a sense of purpose and meaning in life that goes beyond this moment and links us to a future larger than ourselves. As long as children dream dreams inspired by that sort of meaning, they may live in poverty, but poverty never, ever lives in those children."

It's easy to talk thematically about NASA's educational activities. But let me quantify what NASA did last year. We reached 1.13 million students with our Aerospace Education Services Program, more affectionately known as the Space Mobile. Almost 65 percent of those students were at the elementary school level, the age educators have identified as the most critical time for capturing a student's interest in math and science.

Under the Space Mobile program, we conducted over 1,400 in-school workshops for over 19,000 teachers. Students learn best by doing, so in our Space Science Student Involvement Program, SSSIP, students design experiments that could theoretically be conducted on Space Station Freedom or in a NASA wind tunnel. Last year, over 97,000 students learned the joys of scientific discovery through this program.

The Urban Community Enrichment Program, UCEP, specifically targets middle school students in urban areas with high percentages of minorities. Students and teachers participate in hands-on activities and instruction. Nearly 31,000 students in 44 schools benefitted from these intensive eight-week courses.

Almost a quarter of a million students, 245,000 of them, participated in a lunar sample program. Students had the opportunity to conduct experiments with samples of moon rocks that were returned to earth more than 20 years ago, long before they were born. This education program continues Apollo's legacy of discovery.

The Summer High School Apprentice Research Program, SHARP, that Damon participated in, invites underrepresented minority students to work during the summer at a NASA field center on technical projects under the mentorship of scientists, engineers and other professionals. Last year, 196 students participated in SHARP. These are going to be future leaders of the American space program.

NASA sponsors more than 200 elementary and secondary teachers in comprehensive workshops at NASA field centers each summer. The teachers improve their content knowledge through hands-on experience which help them apply aeronautics and space science concepts to the teaching of mathematics, science and technology. Technology developed through the space program has allowed us to provide access to the educational subject matters to teachers at remote sites. Each year NASA conducts satellite video conferences on topics ranging from planetary exploration to space science in the classroom. Roughly 20,000 teachers at 2,000 sites participated.

Space Link, NASA's on-line computer information service, transcends geographic barriers. The service includes current NASA news, data about America's space program, classroom materials, and other information useful to teachers and students. There has been a steady increase in usage since we established Space Link in

1988. The system has approximately 19,000 active users. This year Space Link was added to the InterNet Science On-Line System, which has increased the system's accessibility.

During National Engineer's Week, nearly 1,000 NASA engineers representing every NASA installation in the country visited more than 100,000 students throughout the country. NASA's teacher resource center network distributes NASA information and education materials such as videotapes, slides, software, posters and teacher guides. Centers in 36 states of this Nation serve 90,000 teachers.

A mobile teacher resource center or Laser Van, learning about science and engineering, not lasers that zap into space, unites Federal and private sector resources in a program to provide exciting new math and science educational materials to teachers and students also throughout the country.

Since its introduction almost two years ago, the Laser Van has conducted over 500 workshops for over 6,000 teachers in nearly 30 states. Our Lewis Research Center is fostering a new educational initiative in collaboration with the Cleveland Public Schools and the Cuyahoga Metropolitan Housing Authority. The focus of this project is educational empowerment for families in public housing. Parents actively participate with the in-school and after school activities designed for total family involvement and support.

We also have the Adopt-a-School program in Cleveland, Ohio, which is a partnership between NASA and East High School which is focused on ninth grade studies. Since 1986, over 250 Lewis scientists and engineers have served as tutors, mentors and science fair judges for these students.

These are but a few of the many examples of NASA's ability to reach and inspire America's children. The litany of activities is too lengthy for a single hearing. But based on my review, I am convinced that NASA's education program helps to encourage students like Damon Butler to grow up to be the next generation of aerospace explorers like Dan Brandenstein and perhaps to be the first Martian.

It's an effective program, and we are proud to contribute to the inspiration of the next generation. Dr. Benjamin Mays once said, "The tragedy of life doesn't lie in not reaching your goal. The tragedy lies in having no goal to reach." It's not a disgrace to reach for the stars, but it's a disgrace to have no stars to reach for.

Today NASA has the unique opportunity to use its inspiring mission as a vehicle for teaching and learning, as a shining star that offers hope and promise to all Americans. I feel very strongly that education is not only an opportunity for NASA, it is an obligation to NASA. NASA can leverage its unique facilities and personnel to keep all Americans reaching for the stars.

Mr. Chairman, this concludes my testimony, and I am prepared to receive questions at this point.

Thank you.

[The prepared statement of Mr. Goldin follows:]

Hold for Release Until
Presented by Witness

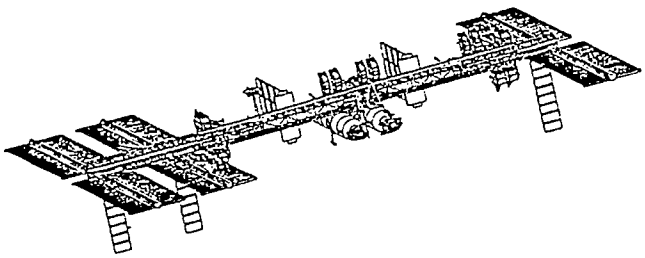
June 10, 1992

Subcommittee on Space

Committee on Science, Space and Technology

U.S. House of Representatives

Statement by:
Daniel S. Goldin
Administrator



102nd Congress

HOLD FOR RELEASE UNTIL
PRESENTED BY WITNESS
JUNE 10, 1992

Statement of
Mr. Daniel S. Goldin
Administrator
National Aeronautics and Space Administration

before the
Subcommittee on Space
Committee on Science, Space and Technology
United States House of Representatives

June 10, 1992

Mr. Chairman, it is a real honor for me to appear before the Subcommittee today to testify on this important national issue -- the role and responsibility of NASA in improving the scientific and technical literacy of America's children.

I should note that today is my first official appearance before the U.S. Congress as the Administrator of NASA, and that is no accident. When I heard of the Subcommittee's interest in this topic, I asked to testify. I wanted this to be my first hearing because I wanted to let the world know what NASA is currently doing in this important arena. As somebody who came from a family of educators, including my father and sisters, I have always felt a civic responsibility to promote and foster educational activities. This has been true of my personal life, as well as my professional life, and this is a commitment that I bring to NASA. I believe that NASA has a unique ability to capture the attention of our Nation's youth, all of our youth, and I believe that NASA can use its programs and educational resources to offer hope and promise to those young people.

Today, it is my pleasure to highlight some of the key activities that NASA has underway.

I am proud to be joined at the table by Captain Daniel Brandenstein, recently returned from commanding the maiden voyage of the Space Shuttle *Endeavour*. That mission was successful for not only capturing the wayward INTELSAT satellite, but also for capturing the excitement and imagination of all Americans -- especially school children.

I am also pleased to introduce to you Damon Butler, a NASA student research apprentice. Damon just graduated from Oxon Hill High School and plans to attend North Carolina State University and major in engineering.

On July 20, 1989, President Bush said: "In 1961, it took a crisis -- the space race -- to speed things up. Today we do not have a crisis. We have an opportunity." He was introducing NASA's return to the Moon and journey to Mars, but he could just as easily have been addressing the Nation's educational reform efforts. NASA has an opportunity to improve science, mathematics, and technology education in America's schools, and we are seizing that opportunity.

Since the inception of the space program, NASA and the Nation's education system have travelled parallel paths. We share the same goals -- exploration, discovery, the pursuit of new knowledge -- and achievement of those goals is interdependent. NASA depends on the education system to produce a skilled and knowledgeable workforce. The education community, in turn, uses the space program to motivate and encourage students to study science, engineering, and technology.

If the United States is to remain at the forefront of space science and aerospace technology and research, then we must provide students with the skills they will need in a highly complex and technical workplace. NASA recognizes that the next generation of science, research, and technology can only be as good as the next generation of scientists, engineers, technicians, and teachers.

NASA's education mission provides a mechanism for helping to ensure a sufficient talent pool to meet the competitive challenge of the 21st century. NASA Headquarters and its nine Field Centers support numerous aerospace education programs and projects. These programs range from elementary to postgraduate school and reach millions of students, elementary and secondary teachers, and university faculty.

If NASA is to continue to attract the "best and brightest" -- while at the same time helping to ensure a more technically literate society in the future -- our educational outreach program must target the entire educational pipeline.

It is our Education Mission to use NASA's inspiring mission, its unique facilities, and its specialized workforce to conduct, and to leverage externally conducted, science, mathematics, and technology education programs and activities. Our Vision is to support systemic change in the education system through expanding and enhancing the scientific and technological competence of all educators involved in the education reform movement. In doing so, NASA will be recognized by the education community as the premier mission agency in support of the National Education Goals and education standards.

NASA's education mission statement recognizes that the Agency's inspiring mission is the cornerstone of its education program. Our purpose is not only to use NASA's mission as content, but to use the Agency's programs and activities to demonstrate the exciting application of subject matter at the precollege level and encourage participation in research at the collegiate level. Three programmatic themes have been identified to organize and provide content for all of NASA's education programs. These themes use the inspiring mission of NASA and its unique facilities to provide a basis for our current and future education activities.

Teaching From Space

Too many children believe that they can't "do" science or that math is "too hard." However, these same students are fascinated by space subjects, especially astronauts. Through an integrated set of programs referred to as "Teaching From Space," NASA capitalizes on the interest students have in space and astronauts to give them positive experiences and opportunities to participate in space research. These programs incorporate not only the human space flight aspect of missions, but also the space science endeavors including the Hubble Space Telescope, Compton Gamma Ray Observatory, Mission to Planet Earth, and the upcoming Mars Observer and Solar Anomalous Magnetosphere Particle Explorer (SAMPEX) missions.

Teaching From Space activities range from the national impact of classroom lessons taught from the Space Shuttle; to students witnessing investigations and demonstrations by Shuttle astronauts; to students and teachers participating with crewmembers who will be onboard Space Station *Freedom*; to future possibilities -- perhaps students operating telescopes on the surface of the Moon or controlling rovers on the surface of Mars.

Teaching From Space also includes nationwide educational activities, such as the SEEDS project (Space Exposed Experiment Developed for Students) which introduced thousands of students across the country to the excitement of scientific discovery. This national science project gave students the opportunity to conduct research with tomato seeds that had been exposed to the space environment while onboard the LDEF satellite for more than six years. Student investigators utilized basic and integrated science process skills as they conducted research, measured and analyzed data, and used the scientific method in a real research experiment. SEEDS made a significant impact toward enhancing the teaching, learning, and enjoyment of science for students worldwide. The words of the teachers say it best: From a secondary teacher in St. Petersburg, Florida: "What a fantastic, motivational learning experience! Seeds from space. Thank you. Thank you. Thank you. Thank you." And from an elementary school teacher in Danville, Indiana: "I represent the children who are the original scientists. I only guide them. THEY do the hands-on learning. I only guide them. AND THAT'S WHAT IT'S ALL ABOUT BECAUSE THESE SPACE KIDS ARE #1!"

Teaching From Space also places special emphasis on learning about Earth. We have a number of educational activities that will involve students directly in Mission to Planet Earth. NASA and the Aspen Global Change Institute are cooperating on a Ground Truth Studies Program for K-12 students. This activity-based science education program integrates local environment issues with global change topics, such as the greenhouse effect, biodiversity loss, and ozone depletion. Students make their own field measurements to learn the importance of ground truth studies to validate remotely sensed data. By utilizing remotely sensed images of their own region, students gain new hands-on skills and insights into local environmental issues and global change topics. More than 1,000 students in 12 states participated in the pilot phase of this project.

Another three-year pilot effort enables classrooms to have direct readout capability from meteorological satellites. The Maryland Pilot Earth Sciences Technology Education Network (MAPS-NET) workshops teach Maryland educators how to acquire and use live images captured directly from meteorological satellites. This program will establish active ground stations in Maryland middle and secondary schools, as well as teacher support networks to ensure a continuing process for introducing Earth science and related technology into schools. The goal of the MAPS-NET program is to establish a Maryland statewide Earth sciences technology education program by linking the Maryland educational system with unique scientific and technical resources including Goddard Space Flight Center, NOAA, and the state's university research base.

We have also established the Global Change Research Graduate Student Fellowships to train the next generation of Earth scientists and engineers to manage data generated by the Earth Observing System and Mission to Planet Earth, and to translate that data into a better understanding of our fragile planet.

These participatory science experiences have a positive impact on a student's lifelong view of science, mathematics, and technology.

The Astronaut Corps is also an integral part of Teaching From Space. Dan Brandenstein will soon give you an astronaut's-eye view of Teaching From Space.

Aeronautics and Space Technology

In addition to those programs thematically based on space science and exploration, we have also developed educational programs to meet specific aeronautics and space technology needs. It is well understood that education is the key if the U.S. is to remain competitive. NASA's education mission provides a mechanism for helping to ensure a sufficient talent pool to meet that competitive challenge.

For example, our Advanced Design Program was developed to expose undergraduate engineering students to the real world of engineering design problems and to provide actual systems design experience for potential graduate students and employees. These students participate in the design of futuristic aerospace technologies such as a lunar factory, a high-speed civil air transport vehicle, or a robotic vehicle for exploring the Martian terrain.

At the Goddard Space Flight Center, graduate students participate in a summer school for High Performance Computational Sciences. This program provides students the opportunity to participate in comprehensive research in Goddard's space and Earth sciences programs. Another program, the High Performance Computing and Communications (HPCC) component of the Graduate Student Researchers Program, was designed specifically to increase the number of graduate students and professionals in this critical base research area. Under NASA's HPCC program, Ames Research Center has extended Internet services for Monta Vista High School in Santa Clara, California, as an experiment in how high school students can access and utilize the services and repositories of the National Research and Education Network.

The University Space Engineering Research Center Program established centers of excellence that are pushing the boundaries in critical technology at nine universities around the country. In addition to performing research, the centers are also providing opportunities for channelling undergraduate and graduate students into educational and career opportunities in these areas. One of the exciting aspects of this program is that students are designing technology experiments that are flying on the Shuttle, and hardware that is being used in NASA missions.

NASA Centers as Learning Laboratories

The NASA Field Centers provide a rich and stimulating environment for education. Utilizing the NASA Centers as Learning Laboratories is the third theme of our education programs. The Centers deliver a wide variety of regional, state, and local education programs. These range in scope from career days, student workshops and apprentice programs to in-depth teacher inservice, graduate student research, and visiting faculty fellowships.

It is at the Field Centers that NASA can make the most concrete contributions to the national education reform movement. For example, in those states receiving National Science Foundation funding for Statewide Systemic Initiatives (SSI), NASA Centers will explore and develop linkages between existing Center education programs and the efforts of SSI. This linkage will include both precollege and higher education programs. In addition, our Centers will develop institutional linkages with state education personnel to ensure that programs address state and local education reform efforts.

In collaboration with the National Science Teachers Association, the National Council of Teachers of Mathematics, and the International Technology Education Association, NASA invites more than 200 elementary and secondary teachers to participate in comprehensive workshops at NASA Field Centers each summer. The teachers improve their content knowledge through hands-on experiences which help them apply aeronautics and space science concepts to the teaching of mathematics, science, and technology.

The Summer High School Apprenticeship Research Program (SHARP) invites underrepresented minority students to work during the summer at a NASA Field Center on technical projects under the mentorship of scientists, engineers, and other professionals. Damon Butler, a third-year SHARP participant, will have the opportunity to speak with you in a few minutes.

The Cooperative Education Program is perhaps the most direct link between the Centers as learning laboratories and the aerospace employment pipeline. In FY 90, NASA's total number of graduating cooperative education students was 358. Of those graduating students, 248 were offered and accepted permanent employment with NASA. That is -- 69.3% of the students who had completed the program stayed with NASA. In FY 89 and 88, 72% and 68% of the graduates were hired, respectively. Those are impressive numbers.

Even more impressive are some of the individual Field Center co-op records. I'll use Goddard as an example. FY 88 hires totalled 71.9% of the co-op graduates; in FY 89 that number climbed to 75.9%; and in FY 90, Goddard was able to engage 82.4% of it's graduating co-op students in permanent employment positions. 75% of Goddard's co-op hires are scientists or engineers. The remaining 25% are in professional administrative positions. 1/3 of Goddard's co-op students come from local schools.

One of the goals of NASA's co-op program is to foster a workforce that is culturally and educationally diverse. It has evolved into an excellent feeder network to increase the percentage of underrepresented minorities and women in NASA's science and engineering workforce.

We also work directly with the broader research community, institutions of higher learning, and other non-profit organizations with a significant minority population to assist them in developing research and education programs and to provide training for undergraduate and graduate students in science and engineering. In partnership with the Nation's Historically Black Colleges and Universities (HBCUs), NASA awards grants directly to HBCU principal investigators to conduct science and space science research. In FY 1991, NASA awarded $20 million to HBCU's for research grants, training grants, fellowships, tuition aid, and equipment -- an increase of 200% over 1983. More than 200 HBCU students and faculty conduct research at NASA centers.

Additionally, since FY 1991, senior NASA managers have been working aggressively to develop and implement management strategies to expand and increase the involvement of other universities with significant enrollments of Hispanics and Native Americans in the Agency's educational and research programs. As a result of these efforts, the number of minority universities involved in NASA's research and educational programs has increased substantially (for example, the University of Texas at El Paso, Brownsville, Pan American, and San Antonio and the Texas A&M, as well as Navajo, Turtle Mountain, and D-Q Community Colleges).

The Centers also provide educational opportunities for teachers and students who do not have direct access to the resources of our facilities. The Aerospace Education Services Program, affectionately known as "Spacemobile," sends education specialists into the field to conduct workshops for teachers and classroom and assembly programs for students. A typical teacher workshop includes how-to and hands-on activities to help teachers incorporate NASA-related topics into classroom activities and programs which supplement existing curricula. School assemblies include demonstrations of aeronautics and space science equipment, principles of rocketry, Space Shuttle operations, and life in space.

Volunteer Efforts by the NASA Workforce

The success of our education program depends on NASA's outstanding personnel -- the scientists, engineers, technicians, and education specialists who often volunteer their efforts to act as mentors and classroom resources.

At the Marshall Space Flight Center, a 2,500 square foot laboratory has been converted tor educational uses. Here in the Discovery Lab, teachers receive special science training and students have the opportunity to participate in laboratory experiments not available in their own schools. The heart of this project is a team of current and retired Center and contractor employees who volunteer their time and talents.

Volunteers are also an integral part of NASA's annual support of National Engineers Week. In 1992, nearly 1,000 engineers visited more than 100,000 students throughout the country during the week of February 16-22. Every NASA installation participated -- from Headquarters, to Ames Research Center, to Wallops Flight Facility, to the Jet Propulsion Laboratory.

Education Materials and Information Dissemination

To facilitate the Agency's impact on the national education system, NASA is developing a presence in every state. This national network is the mechanism through which we reach out to the entire education community.

In the mid-1980's, NASA began the Teacher Resource Center Network, which provides dissemination points for the distribution of NASA information and education materials such as videotapes, slides, software, posters, and teacher's guides. Currently, this network is located at all NASA Centers and in museums, planetaria, schools, and universities in 36 states. The Teacher Resource Center Network currently serves over 90,000 teachers annually.

At the post-secondary level, the National Space Grant College and Fellowship Program was established to form a national network of institutions in support of the NASA mission. Currently 47 states have formed Space Grant Consortia, linking over 340 colleges, universities, nonprofits, businesses, and state and local governments. By this summer, it is expected that Space Grant will be active in all 50 states, the District of Columbia, and Puerto Rico. This network will expand NASA's research, education, and public service presence throughout the country.

Educational Technologies

A presence in every state is not sufficient to reach all students and teachers. However, with the proliferation of educational technologies such as satellite communications and on-line computer information systems, every school, no matter how remote, can have immediate access to the latest information and educational materials.

Using technology as an educational tool has a second advantage: today's students are already comfortable with its applications in the home: Nintendo, VCRs, personal computers, and cable TV.

NASA Select, the Agency's internal communication service, is a valuable teaching tool. It offers informational and educational programs as well as real-time mission coverage, accessible via satellite dishes and cable television systems. Three one-hour segments are reserved each day exclusively for sixty-minute classroom-suitable programs. All programs may be taped. Aimed at inspiring students to achieve in math and science, these programs range from live interactive shows, to "Launch Box," a series produced by the Nickelodeon cable network and NASA. NASA is working closely with the cable industry to make NASA Select available to schools nationwide.

Spacelink is NASA's on-line computer information system for educators. The service includes current NASA news, data about America's space program, classroom materials, and other information useful to teachers and students. There has been a steady increase in usage since we established Spacelink in 1988. There are approximately 19,000 active users of the system, of which 4,000 are teachers and 6,000 are students. This year, Spacelink was added to the science on-line system Internet which increases the system's accessibility.

NASA is also developing a variety of software and multimedia products for education. For example, in partnership with a public broadcasting programmer and a leading textbook publisher, NASA is producing an interactive videodisc with integrated software on the subject of Earth systems science in alignment with the Mission to Planet Earth.

Leveraging

The programs which I have discussed are excellent, but there are limits to what NASA can directly accomplish. Therefore, a fundamental component of our education program is to leverage NASA's resources through partnerships with public and private organizations. For example, we work in alliance with professional associations in the conduct of our education program to enhance our impact upon the education system. Also, we have recently engaged our major aerospace contractors in a collaborative effort to guide activities in science, mathematics, and technology education. This program, the NASA Industry Education Initiative, has already proven successful and is about to issue a report documenting its first year of work and describing future objectives.

Evaluation

Evaluating the success of our programs is an essential element of the NASA management plan. This principle applies as much to our education program as to the management of our spacecraft. Therefore, cost-effectiveness studies, student impact investigations, and assessments of our curriculum materials are being conducted and strengthened while the scope of these efforts is being expanded.

However, the measures of success in the social sciences are not as clear-cut and objective as in the physical disciplines. Consequently, we have initiated a study with the National Research Council to identify evaluation indicators for our program. With guidance from this study developed by a prestigious and respected organization, we will continue improvement and excellence within NASA's education program.

Conclusion

NASA's education program helps to encourage students, like Damon Butler, to grow up to be the next generation of aerospace explorers, like Dan Brandenstein. It's an effective program, and we're proud to contribute to the development of these young people.

A few weeks ago, a third grade teacher was addressing a national space group. She said that "it is true that a good education is the key to the future, but more important, that the corollary is also true -- the future is the key to a good education. Unless something exciting is going on in the present that indicates that the future is there -- and that it's different and exciting and better -- then no student is going to work for that future. For students -- as for most people -- it takes a sense of connection to the future to keep the present moving forward."

The scope of NASA's role in education is limited. However, by leveraging the Agency's unique resources -- its facilities and personnel -- NASA has the opportunity to use its inspiring mission as a vehicle for teaching and for learning. I feel very strongly that education is not only an opportunity for NASA, it is an obligation.

National Aeronautics and
Space Administration

Washington, D.C. 20546
Phone: 202/453-8400

Biographical Data

Daniel S. Goldin

Administrator
National Aeronautics and Space Administration

Daniel S. Goldin became the ninth NASA Administrator on April 1, 1992. Prior to his nomination, he was Vice President and General Manager of the TRW Space & Technology Group, Redondo, Calif., where he managed the development and production of advanced spacecraft, technologies and space science instruments.

Goldin began his career as a research scientist at NASA's Lewis Research Center, Cleveland, from 1962 to 1967. While there, he worked on electric propulsion systems for human interplanetary travel.

He has held positions at TRW since 1967 when he became a member of the technical staff. During his tenure as Vice Pesident and General Manager, the Space and Technology Group pioneered advanced technologies including superconductivity, composites and electrooptics and built 13 spacecraft that continue to operate successfully in orbit. These include the launch and operation of NASA's Tracking and Data Relay Satellite-5 and the Compton Gamma Ray Observatory. The group also has worked on other NASA programs, including the successful grinding and testing of the world's two largest X-ray mirrors for the Advanced X-ray Astrophysics Facility.

The Space & Technology Group won the 1990 Goddard Award for Quality and Productivity, was a finalist in 1991 for NASA's highest quality award for contractors - the George M. Low trophy - and in 1992, the NASA/TRW team received the National Space Club's Nelson P. Jackson Aerospace Award for the Compton Gamma Ray Observatory.

Prior to that position, Goldin managed several advanced technology programs of high national priority. He led TRW's efforts in the design, development and production of the communications payload for the U.S. Air Force's MILSTAR communications satellite and managed the direct broadcast payload for NASA's communications technology that became the forerunner of current direct broadcast television systems. He also has held leadership positions on several NASA advanced studies for interplanetary, asteroid-flyby and comet rendezvous missions.

Goldin, born in New York City on July 23, 1940, received a Bachelor of Science degree in mechanical engineering in 1962 from the City College of New York. He is married to the former Judith Linda Kramer of New York City. They have two daughters, Aerial and Tania, who reside in California.

April 1992

Mr. HALL. Thank you.

I believe we will hear the testimony of all three, and then go into questions.

Mr. Tanner from Tennessee, I recognize you for any statement you want to make.

Mr. TANNER. Thank you, Mr. Chairman.

I want to say how pleased I am and how timely I think the committee is holding this hearing. I am going to have to leave to go back to the floor, but I wanted to welcome the President of the Tennessee Education Association, who is here with us today, and whose statement I look forward to hearing.

Mr. HALL. Thank you.

I may tell the panel, and members of the other two panels, that there are about five things going on today, including a nine-hour debate on the balanced budget amendment. The members will come and go. But your testimony will come and stay.

[Laughter.]

Mr. HALL. It will be placed of record, into the written word, and disseminated to all the members and all the staff, and will be studied, and is very useful.

Okay, Norm Mineta—I recognize the gentleman from California.

Mr. MINETA. Thank you very much, Mr. Chairman.

I just want to congratulate you for conducting this hearing on the importance of the role that the U.S. space program plays in stimulating achievement in science and math education. I have often said that it is no coincidence that the growth of our Nation's high technology have paralleled the years of NASA's greatest activity and accomplishment.

NASA has contributed greatly as a primary source of engineers and scientists who have bolstered our Nation's economic competitiveness and high technology and aerospace industries.

It is clear that throughout the last 30 years NASA and our space program have inspired and educated children of all ages. It is important for us to examine NASA's educational activities at a time when it appears our children are sadly lacking inspiration.

There is a great example of how NASA encourages school children located at NASA Ames Research Center in Mountain View, California, which borders my district. The Ames Aerospace Encounter, situated in Ames' supersonic wind tunnels, features numerous activity stations designed to explain a variety of aerospace concepts to students in grades K-12.

The activity stations include high resolution graphics work stations to show students how to design airplanes, a rotating chair and gyroscope to demonstrate Newton's laws of motion and how spacecraft are stabilized in orbit and computers that teach students about remote sensing in the environment.

Ames Aerospace Encounter is just one example illustrating that our space program is about more than just hardware. NASA and our space program continue to provide our children with visions of the future and a vision of where this Nation will go and what we will do in the international laboratory of outer space.

So I look forward to not only the testimony but also the leadership that is being provided by the new Administrator, Mr. Goldin. I am quite sure that as we try to find our way through the budget

issues and into the future, his background and experience level will create a great level of new vision and frontiers for NASA.

Thank you very much, Mr. Chairman.

Mr. HALL. Thank you. The Chair recognizes Captain Brandenstein.

STATEMENT OF DAN BRANDENSTEIN, CAPTAIN, UNITED STATES NAVY, NASA ASTRONAUT

Captain BRANDENSTEIN. Thank you, Mr. Chairman.

I am honored to appear here today and share my observations on the youth and education and NASA's influence on both. From my personal experience as 14 years as an astronaut, I have had numerous occasions to interact with the youth of America.

One thing is obvious. To the youth of America, the space program is challenging, it's exciting, it has part of their life now and also their future. It has a great deal of effect on today's youth. It's inspiration. It inspires them to study hard and to be creative to problem solving. From the type of education they are getting today, they are learning to do goal setting, and setting careers for the future. They do a great deal of team building in a variety of their educational programs.

Just to the inspiration, the vision the space program provides excites and motivates the youth and the schools to look into the future. This tremendous interest in space and education is manifested in the following ways. First of all, we have the space camps. These are ways that NASA currently is not even very much involved with. But the space camps throughout the country are filled to capacity. And these space camps—when I was a kid you went fishing and rode a canoe around. These are camps with educational experiences. They do a great deal of team building, high technology education and math and physics.

Likewise in a similar vein we have the Challenger Centers, 12 of which are around the country. Once again, they are very much active in teaching our youth and the children, and they use them to the maximum. Additionally, we have the Young Astronaut program. These are all programs that you probably are all very much aware of.

In addition to that, we have individual school initiatives. Prior to my flight, I got a letter from St. Louis where a group of students were doing a week's program called Marsville, where they had a simulated mission to Mars. This unit was an individual school's initiative. During my mission, I received that pile of news clippings from an old college classmate of mine who is a teacher in Northern Wisconsin.

In conjunction with our mission on Endeavour, this particular school district was running a mission of their own. And this was started from the initiative of one teacher. They took a school bus and built it into a look-alike training center. Throughout the week they ran missions and 650 of the sixth-graders in that town participated in this program. They were astronauts, they were ground patrollers, they were scientists, they even had some of the students being reporters. The articles don't say if any of them were politicians.

[Laughter.]

Captain BRANDENSTEIN. But it was very much involved on an individual school's initiative. Not only that, but they are going beyond. In the very last article in these clippings, they now have, in addition to the school bus, they have a trailer that they are making into a space station for their future programs.

Beyond that, we also get a steady stream of leaders into the astronaut office where the students relate to us their dreams, their goals, and their accomplishments. We get these letters from all ages, all grade levels, and all levels of capability. I have one here from a learning-disabled boy. He goes to a prep school in Southern Illinois, where my daughter went. I invited the school to com and see the launch.

The director of the school couldn't take everyone, so he set some prerogatives and some requirements that they had to meet to decide who would make it. Here is part of what this young man wrote.

"I thought about how I would feel about not going. So I worked and I worked so that I could go. This helped me think of the future, and what I could be doing in the future for myself and for other people. I have learned a lot of cool things about it." It is signed by Eric Marlette.

So those are the types of things that the space program inspires outside of NASA. Within NASA, there are many programs, like Mr. Goldin has addressed, and I will touch on a few of those again. But these are ones that I have been personally involved in in my career. Two of them were really unique programs. I was very fortunate to be involved in both of them.

One that was mentioned was the Name the Orbiter program. Not only did we end up with a great name for the orbiter, with a great history behind it, but it also instilled the students, as part of this program, to develop classroom projects, and to develop teamwork and more interest and knowledge in science.

Another program I was fortunate to be involved with was the SEEDS program. This was a program where they launched over 12 million tomato seeds, they stayed in orbit for almost six years. I was fortunate enough to fly the mission that retrieved them. The seeds were sent to a variety of schools, and the students could conduct experiments.

From that program, three million students, 40,000 schools in the United States and foreign countries, received seeds and got to participate in growing these seeds, comparing them to seeds that had stayed on earth to see if the environment of space had in any way changed the seeds. It was really exciting to talk with these students, because they had direct involvement in a NASA program.

As a matter of fact, I will leave it for the record if you like, it's a book on the seeds, it has all the scientific results that NASA received back from the students as part of this program. It gave them a chance to participate in scientific research and really motivated them.

Mr. Goldin also mentioned the aerospace education programs, or space mobiles. We in the Astronaut Office frequently tag up with these space mobiles. They generally come into a town or a school district for a week, and set up a whole week's worth of programs.

Quite often, we are fortunate enough to join up with them and participate in part of it. It has given me the opportunity to see the real professionalism of the people that are involved, the NASA employees who are doing this program, and also to see the response from the young people.

The NASA centers all have a very active program of education. They have career days, they have student workshop programs, they have teacher workshop programs, and they have tours and visitors centers associated with them. Once again, it was my personal experience in the space center, the Johnson Space Center, where the students come through the various training facilities, they stand there in wide-eyed amazement as we do some of our training, jumping out of space shuttle simulators, diving into swimming pools with all our flight gear on. They are in wide-eyed amazement and they are full of questions. There is never an end to the questions. They are very insightful and really interested, and really want to learn.

Another opportunity that I personally feel is somewhat underutilized, and that is the NASA Select TV network. We have a satellite available, it is free, and it has every mission from lift-off to landing that is covered. In addition to that, we have educational programs daily on them when missions aren't running.

These are free, and we should encourage every single cable network in the country to dedicate a single channel to the education of the youth and make it available. In some places it's done, and in some places it's not. Some schools have a dish antenna that picks up this program for their school system, some don't have it available. But it is a very unique opportunity that I believe is somewhat underutilized.

Within the Astronaut Office, we have been very active to the best of our ability to promote education. We do over 5,000 public appearances a year, and that's with less than 100 astronauts, of which a great majority are to schools and to young folks. We tell them about the diversity of background within the astronaut corps. We have medical doctors, we have a variety of scientist, engineers, pilots, non-pilots. But the common thread to all the astronauts is their depth of education in science, mathematics and technology.

In addition to that, everyone there can be a prime example to a young student of setting goals and achieving them. It also shows what hard work will do in achieving those goals, and that excellence is important, regardless of what type of career you end up choosing.

In summation, the space program instills a very positive influence on the youth of America. It inspires them to pursue an education now and in the future. It inspires them to excel in all they do and to persevere regardless of challenges. Just as we on the flight of Endeavour in our first attempt to rescue the satellite, through teamwork and perseverance we were able to successfully complete our mission.

Within the Astronaut Office, we try to do it on ever mission, we are not always successful, but we have an educational video that we have made, it's targeted for the middle levels of school. I also have three of those on this tape available. They also come with a teacher's guide. On every mission, we attempt to make a video so

we have something that can go out to the schools, and they can use it to educate the students. It's a program that's relatively new, but has been going very well.

The astronauts are very enthused about doing this on orbit. Our video from Endeavour's flight is not complete yet, but it's getting there. The subject on ours was the comparison of the flight of Endeavour, or life on the Space Shuttle Endeavour compared with Captain Cook's voyage of exploration back in the 1700s.

The other three we have here are Space Basics, which is essentially orbiter mechanics for young people. We have found that young people are pretty bright and that older folks can learn a lot about orbiter mechanics from it. We have Going for EVA, which explains what it takes to do a space walk, and Newton in Space, basic physics, but how it applies to operations in space.

We will continue to emphasize our education to the youth of America. The education is just another compelling reason to have a vigorous space program today and in the future.

That concludes my testimony, and thank you very much.

[The biographical sketch of Captain Brandenstein follows:]

Biographical Data

NASA

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

NAME: Daniel C. Brandenstein (Captain, USN)
NASA Astronaut

BIRTHPLACE AND DATE: Born January 17, 1943, in Watertown, Wisconsin.
His parents, Mr. and Mrs. Walter Brandenstein, are residents of Watertown, Wisconsin

PHYSICAL DESCRIPTION: Brown hair; blue eyes; 5 feet 11 inches; 195 pounds

EDUCATION: Graduated from Watertown High School, Watertown, Wisconsin, in 1961; received a bachelor of science degree in mathematics and physics from the University of Wisconsin (River Falls) in 1965

MARITAL STATUS: Married to the former Jane A. Wade of Balsam Lake, Wisconsin
Her parents, Mr. and Mrs. Albert Wade, reside in Balsam Lake.

CHILDREN: Adelle, January 7, 1972.

RECREATIONAL INTERESTS: He enjoys skiing, sailing, basketball, softball, golf, and woodworking.

ORGANIZATIONS: Associate Fellow, American Institute of Aeronautics and Astronautics. Member, Society of Experimental Test Pilots, United States Naval Institute, and Tailhook Association

SPECIAL HONORS: Awarded the Defense Superior Service Medal, the Distinguished Flying Cross, 17 Air Medals, 2 Navy Commendation Medals, Meritorious Unit Commendation, Distinguished Flying Medal, 2 NASA Outstanding Leadership Medals, 3 NASA Space Flight Medals, National Defense Service Medal, Armed Forces Expeditionary Medal, Legion of Honor (France), Medal of King Abdul Aziz (Saudi Arabia), Vietnam Service Medal, Vietnamese Air Gallantry Cross with Silver Star, Vietnamese Gallantry Medal, and Republic of Vietnam Campaign Medal; Distinguished Alumnus, University of Wisconsin, River Falls.

EXPERIENCE: Brandenstein entered active duty with the Navy in September 1965 and was attached to the Naval Air Training Command for flight training. He was designated a naval aviator at Naval Air Station, Beeville, Texas, in May 1967, and then proceeded to VA-128 for A-6 fleet replacement training. From 1968 to 1970, while attached to VA-196 flying A-6 Intruders, he participated in two combat deployments on board the USS Constellation and the USS Ranger to Southeast Asia and flew 192 combat missions. In subsequent assignments, he was attached to VX-5 for the conduct of operational tests of A-6 weapons systems and tactics; and to the Naval Air Test Center where, upon graduation from the U.S. Naval Test Pilot School, Patuxent River, Maryland, he conducted tests of electronic warfare systems in various Navy aircraft. Brandenstein made a nine-month deployment to the Western Pacific and Indian Ocean on board the USS Ranger while attached to VA-145 flying A-6 Intruders during the period March 1975 to September 1977. Prior to reporting to Houston as an astronaut candidate, he was attached to VA-128 as an A-6 flight instructor

He has logged 6,300 hours flying time in 24 different types of aircraft and has 400 carrier landings.

NASA EXPERIENCE: Selected by NASA in January 1978, Brandenstein became an astronaut in August 1979. He was ascent spacecraft communicator (CAPCOM) and a member of the astronaut support crew for STS-1. It was also the first flight of the Space Shuttle. He was subsequently assigned to the STS-2 astronaut support crew and was the ascent CAPCOM for the second Space Shuttle flight. Brandensteinhas flown three missions: STS-8 in 1983, STS-51G in 1985, and STS-32 in 1990. Following his second space flight, Brandenstein served as the Deputy Director of Flight Crew Operations until his assignment to his current position of Chief of the Astronaut Office.

Brandenstein was pilot on STS-8, his first flight, which launched at night from the Kennedy Space Center, Florida, on August 30, 1983. This was the third flight for the Orbiter Challenger and the first mission with a

- more -

night launch and night landing. During the mission crew members deployed the Indian National Satellite (INSAT-1B); operated the Canadian-built Remote Manipulator System (RMS) with the Payload Flight Test Article (PFTA), operated the Continuous Flow Electrophoresis System (CFES) with live cell samples, conducted medical measurements to understand biophysiological effects on space flight; and activated various earth resources and space science experiments along with four "Getaway Special" canisters. STS-8 completed 98 orbits of the Earth in 145 hours before landing at Edwards Air Force Base, California, on September 3, 1983.

On his second mission (June 17-24, 1985), Brandenstein commanded the crew of STS-51G aboard the Orbiter Discovery. During this seven-day mission crew members deployed communications satellites for Mexico (Morelos), the Arab League (Arabsat), and the United States (AT&T Telstar). They used the Remote Manipulator System (RMS) to deploy and later retrieve the SPARTAN satellite which performed 17 hours of x-ray astronomy experiments while separated from the Space Shuttle. In addition, the crew activated the Automated Directional Solidification Furnace (ADSF), six "Getaway Specials", participated in biomedical experiments, and conducted a laser tracking experiment as part of the Strategic Defense Initiative. The mission was accomplished in 112 Earth orbits in approximately 170 hours.

Brandenstein then commanded the crew of STS-32 (January 9-20, 1990). In the longest Shuttle mission to date, crew members aboard the Orbiter Columbia successfully deployed the Syncom IV-FS satellite, and retrieved the 21,400-pound Long Duration Exposure Facility (LDEF) using the RMS. They also operated a variety of middeck experiments including the Microgravity Disturbance Experiment (MDE) using the Fluids Experiment Apparatus (FEA), Protein Crystal Growth (PCG), American Flight Echocardiograph (AFE), Latitude/Longitude Locator (L3), Mesoscale Lightning Experiment (MLE), Characterization of Neurospora Circadian Rhythms (CNCR),and the IMAX camera. Additionally, numerous medical test objectives, including in-flight Lower Body Negative Pressure (LBNP), in-flight aerobic exercise and muscle performance were conducted to evaluate human adaptation to extended duration missions. Following 173 orbits of the Earth in 261 hours, the mission ended with a night landing in California.

With the completion of his third flight, Brandenstein logged 576 hours in space.

CURRENT ASSIGNMENT: Captain Brandenstein is Chief of the Astronaut Office and is also assigned to command Shuttle Mission STS-49. During this seven-day mission, crew members will retrieve, repair, and redeploy the International Telecommunications Satellite (INTELSAT), and will also perform three EVAs (space walks) as part of an extensive test of EVA techniques to be employed during assembly of Space Station Freedom. STS-49 is scheduled for launch in early 1992 aboard the new Space Shuttle Endeavour.

FEBRUARY 1992

NASA

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MH-0012/6-92

Mission Highlights STS-49

Space Shuttle *Endeavour*

May 7 - 16, 1992

Commander:
Daniel C. Brandenstein, Capt., USN
Pilot:
Kevin P. Chilton, Lt. Col., USAF
Mission Specialists:
Richard J. Hieb
Bruce E. Melnick, Cmdr., USCG
Pierre J. Thuot, Cmdr., USN
Kathryn C. Thornton, Ph.D.
Thomas D. Akers, Lt. Col., USAF

Liftoff of NASA's newest Space Shuttle, *Endeavour*.

Major Mission Accomplishments

- Completed the first flight of the Space Shuttle orbiter *Endeavour*
- Performed three rendezvous with the *INTELSAT VI* satellite.
- Performed a manual capture, attachment of a new rocket motor, and deployment of the *INTELSAT VI* satellite.
- Conducted a spacewalk to perform a series of tests and evaluations to aid in verification and planning of procedures for Space Station *Freedom* construction and crewmember self-rescue.
- Obtained valuable operational and training experience to enhance future spacewalk operations.
- Performed four spacewalks on a single Space Shuttle mission (twice as many as on any previous mission).
- Conducted first use of the orbiter drag chute.
- Performed a three person spacewalk for the first time in history.
- Completed the two longest spacewalks in history (8 hours 29 minutes and 7 hours 45 minutes).
- Completed the longest spacewalk by a female astronaut (7 hours 45 minutes).
- Increased the total number of hours of spacewalking experience in the Space Shuttle program by 37 percent. (Total time of spacewalks: 25 hours 27 minutes.)

The maiden flight of NASA's newest Space Shuttle, *Endeavour*, captured the excitement, spirit, and flexibility of manned space flight. The seven crewmembers experienced a roller coaster of emotions throughout their nine day flight while trying to capture the stranded *INTELSAT VI* satellite and perform an Extravehicular Activity (EVA) to evaluate Space Station *Freedom* construction techniques.

In March of 1990, the *INTELSAT VI F-3* communications satellite was carried to space by a Titan launch vehicle. A problem with the launch vehicle stranded the satellite in a 560-kilometer-high orbit instead of deploying it in its planned geostationary orbit of 36,000 kilometers above Earth. Since its failed launch, the 4,064 kilogram communications satellite had been orbiting Earth in an orbit unusable for communications.

One of the primary objectives of the STS-49 mission was to capture *INTELSAT* and fit it with a new rocket motor. Once attached, the new motor would propel the satellite to its proper orbit where it would begin service by providing a relay link for the equivalent of 120,000 two-way simultaneous telephone calls and three television channels. The capture would be an even greater challenge since *INTELSAT* was not designed to be retrieved by the Space Shuttle.

After the trouble-free launch of *Endeavour*, flight controllers in Washington D.C. commanded the *INTELSAT* satellite to fire its thrusters for the first of four maneuvers to lower and circularize the spacecraft's orbit. The *Endeavour* crew also performed maneuvers to begin closing the distance between the orbiter and the satellite. During the first three days of the mission, while Dan Brandenstein and Kevin Chilton maneuvered *Endeavour*, other crewmembers completed checkout of the four Extravehicular Mobility Units (EMUs) to be used during the unprecedented three planned spacewalks. Led by Bruce Melnick, the crew also checked out the orbiter's 15-meter-long Remote Manipulator System (RMS), or robot arm, that would be used in the capture of *INTELSAT*.

Three trouble-shooting astronauts, wearing Extravehicular Mobility Units (EMU's) fitted with weights for neutral buoyancy, are shown in the Weightless Environment Training Facility (WETF). They verified the techniques that would be used the next day by *Endeavour* crewmembers.

STS-49 Crewmembers (beginning bottom row, right and going clockwise) Richard J. Hieb, Thomas D. Akers, Kathryn C. Thornton, Pierre J. Thuot, Daniel C. Brandenstein, Kevin P. Chilton, and Bruce E. Melnick.

The first attempt to capture the stranded satellite occurred on the fourth day of the mission. Two crewmembers in EMUs, Pierre Thuot poised at the end of the RMS and Rick Hieb positioned in the orbiter payload bay, planned to attach a capture bar which would provide a grapple fixture for later use by the RMS. However, the satellite proved to be more sensitive to external forces than previously thought. After several attempts at capture, Endeavour maneuvered away so that the satellite could be stabilized overnight.

Additional attempts on the fifth day again proved unsuccessful. Although the satellite was stabilized after the first attempt, the capture bar still was unable to grab hold. The crew was then given one day off before attempting a third try. During the day off, the crew suggested a plan to use three crewmembers to grab and hold the satellite by hand. Although a three-person EVA had never been attempted before, a tiger team of flight controllers, engineers, and fellow astronauts on the ground developed, evaluated, and verified the entire procedure in one day.

Throughout the day between rescue attempts, the crew was busy with a variety of activities. In addition to participating in the development of the rescue plan for *INTELSAT*, they conducted medical tests evaluating the human body's performance in

microgravity, and recorded footage for an educational video comparing Captain Cook's first voyage on *Endeavour* and the maiden voyage of the Space Shuttle of the same name.

The public interest and excitement in the stubborn satellite began to grow after the first rescue attempt. NASA received a deluge of suggestions on possible ways for the crew to grab the satellite. These ideas included: using magnets attached to the EVA crewmember's feet, using bungee cords, lassoing the satellite, using a large glove-like device to haul in *INTELSAT*, and applying velcro to the satellite.

The third attempt at capture added crewmember Tom Akers to the original team of Thuot and Hieb in the first ever 3-person EVA. The crewmembers positioned themselves 120 degrees apart on the circumference of the satellite's base, forming three stable legs for the capture. Commander Brandenstein gently maneuvered *Endeavour* directly under the 4,064 kilogram satellite so that the three crewmembers could reach up and grab it by hand. Hieb and Thuot attached the grapple fixture as Akers continued to stabilize the satellite. Then, Melnick, operating the orbiter's robot arm, was able to complete the grapple of the satellite.

Following capture, the satellite rescue operation proceeded as planned. The *INTELSAT* satellite was connected to the new rocket motor and sent to geostationary orbit. This third EVA was the first time more than two EVAs were conducted on a Shuttle mission. It was also the longest EVA in history, 8 hours 29 minutes, surpassing the record of 7 hours 37 minutes held by the Apollo 17 astronauts.

Still, STS-49 was not finished breaking records. With *Endeavour* performing almost flawlessly, NASA mission managers decided to extend the mission two days to complete more mission objectives and allow the crew enough time to prepare for landing. This allowed two crewmembers, Tom Akers and Kathy Thornton, to perform the Assembly of Station by EVA Methods (ASEM) experiment, the fourth EVA on the flight and another first. Under the direction of Bruce Melnick, the spacewalkers built a pyramid shaped truss structure and then docked a pallet to it using *Endeavour's* robot arm — thus simulating the installation of a crew module node to a space station truss structure. These activities took longer than had been estimated prior to the mission and pointed to the need for further evaluation of assembly concepts on-orbit. The crew also tested self-rescue devices for an EVA crewmember who may become untethered from Space Station *Freedom*. Although originally scheduled for two EVAs and now limited to one, most of the objectives of ASEM were met by the *INTELSAT* spacewalks and this fourth spacewalk.

Mission Specialists Rick Hieb, left, Pierre Thuot, right, and Tom Akers, center grab hold of the *INTELSAT VI* satellite

The STS-49 crew also conducted the mid-deck Commercial Protein Crystal Growth (CPCG) experiment. The CPCG experiment provides a means of producing large, high-quality protein crystals. Larger, higher quality crystals can be grown in space due to the absence of distortions produced on the ground by gravity. Knowing the precise structure of these complex molecules provides the key to understanding their biological function.

Landing of *Endeavour* provided another first, the use of the orbiter drag chute which reduced landing roll-out distance and orbiter tire and brake wear. The drag chute was just one of many improvements made to *Endeavour*. *Endeavour* features updated avionics systems, mechanical systems, and modifications for future use as an Extended Duration Orbiter (EDO). Although not used on STS-49, the EDO modifications would allow *Endeavour* to remain in space for as long as 28 days.

The maiden flight of *Endeavour* included many firsts, but above all, it demonstrated the flexibility of the Space Shuttle program and the ability of the ground control and flight crew team to rise to meet the challenges of space flight operations.

Mission Facts

Orbiter: *Endeavour*
Mission Dates: May 7-16, 1992
Commander: Daniel C. Brandenstein, Capt., USN
Pilot: Kevin P. Chilton, Lt. Col., USAF
Mission Specialist: Richard J. Hieb
Mission Specialist: Bruce E. Melnick, Cmdr., USCG
Mission Specialist: Pierre J. Thuot, Cmdr., USN
Mission Specialist: Kathryn C. Thornton, Ph.D.
Mission Specialist: Thomas D. Akers, Lt. Col., USAF
Mission Duration: 8 days, 21 hours, 17 minutes
Kilometers Traveled: 5,950,590
Orbit Inclination: 28.35 degrees
Orbits of Earth: 141
Orbital Altitude: 366 km
Payload Weight Up: 14,648 kg
Orbiter Landing Weight: 82,885 kg
Landed: Concrete runway 22, Edwards Air Force Base
Payloads and Experiments:
INTELSAT VI F3 reboost
Assembly of Space Station by EVA Methods
Commercial Protein Crystal Growth
Medical Experiments
Earth Observations
Educational Activities:
Educational Videotaping

STS 49 Crew Patch

Crew Biographies

Commander: Daniel C. Brandenstein (Capt., USN). Brandenstein was born in Watertown, Wisconsin. He earned a bachelor of science degree in mathematics and physics from the University of Wisconsin, River Falls. After graduation, he became an aviator in the U.S. Navy and flew 192 combat missions in the Vietnam War. Brandenstein also tested weapons systems and tactics aboard the A-6 aircraft. Following graduation from the U.S. Naval Test Pilot School, he conducted tests of electronic warfare systems in various Navy aircraft. Brandenstein has logged 6,300 hours flying time and made 400 carrier landings. He has previously flown as a pilot on the STS-8 mission and was the commander on the STS-51G and STS-32 missions. He has been Chief of the Astronaut Office since 1987.

Pilot: Kevin P. Chilton (Lt. Col., USAF). Kevin Chilton was born in Los Angeles, California. He earned a bachelor of science degree in engineering sciences from the USAF Academy and a master of science degree in mechanical engineering from Columbia University. After graduating from Air Force pilot training, he served as a combat ready pilot and instructor in the RF-4 Phantom II and the F-15 Eagle. Following graduation from the USAF Test Pilot school, he conducted weapons and systems tests in the F-15 and F-4. He has logged over 3,000 hours of flight time in more than 20 different types of aircraft. This is his first space flight.

Mission Specialist: Richard J. Hieb. Richard Hieb was born in Jamestown, North Dakota. He received a bachelor of arts degree in mathematics and physics from Northwest Nazarene College and a master of science degree in aerospace engineering from the University of Colorado. Following graduation, he joined NASA and worked in many different areas of flight operations, including crew procedures development and spacecraft rendezvous procedures. Hieb flew previously on the STS-39 mission as a mission specialist.

Mission Specialist: Bruce E. Melnick (Cmdr., USCG). Bruce Melnick was born in New York, New York, but considers Clearwater, Florida to be his hometown. He earned a bachelor of science degree in engineering from the U.S. Coast Guard Academy and a master of technology in aeronautical systems from the University of West Florida. During seven years as a Coast Guard rescue pilot and later conducted many of the tests on the Coast Guard's HH-65A "Dolphin" helicopter. He has logged over 4,900 flying hours, mostly in helicopters and T-38 aircraft. Melnick flew previously as a mission specialist on Mission STS-[illegible].

Mission Specialist: Pierre J. Thuot (Cmdr., USN). Pierre Thuot was born in Groton, Connecticut, but considers Fairfax, Virginia, and New Bedford, Massachusetts, to be his hometowns. He received a bachelor of science degree in physics from the U.S. Naval Academy and a master of science degree in systems management from the University of Southern California. He flew the F-14 Tomcat and made deployments to the Mediterranean and Caribbean Seas aboard the carriers USS John Kennedy and USS Independence. He has also worked as a project test flight officer at the Naval Air Test Center. Thuot has recorded over [illegible] flight hours, and made more than 270 carrier landings. He flew previously as a mission specialist aboard Mission STS-36.

Mission Specialist: Kathryn C. Thornton (Ph.D.). Kathryn Thornton was born in Montgomery, Alabama. She earned a bachelor of science degree in physics from Auburn University and master of science and doctorate of philosophy degrees in physics from the University of Virginia. She was awarded a NATO Postdoctoral Fellowship at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany, and later worked as a physicist at the U.S. Army Foreign Science and Technology Center. Thornton was also a mission specialist aboard Mission STS-[illegible].

Mission Specialist: Thomas D. Akers (Lt. Col., USAF). Tom Akers was born in St. Louis, Missouri, but considers his home Eminence, Missouri. He received bachelor and master of science degrees in applied mathematics from the University of Missouri. He worked four years as the high school principal in Eminence before joining the Air Force. As a flight test engineer, he worked on several weapons development programs while flying F-4 and T-38 aircraft. Akers served previously as a mission specialist aboard STS-41.

Flight Crew Operations Directorate, NASA Johnson Space Center, June, 1992

Mr. HALL. Thank you, Captain Brandenstein.

Damon, we are very honored to recognize you at this time. If you will, just give us half a moment here to let one of our members who has just arrived make an opening statement. He is a very valuable member of this committee. I have told this a time or two, but I think people need to know who Congressman Johnson from Texas is.

He is really a man about whom books will be written and movies will be made one day. He was a prisoner of war, son, for seven years, representing this country. Over four of those years he was in solitary confinement. A lot of people really have suffered for the right for you to go to school and for the right for you to come here and testify to us, and for us to have the right to represent anyone.

So I will recognize him, if you will yield, we will recognize Congressman Sam Johnson for an opening statement.

Mr. JOHNSON. Thank you, Mr. Chairman. I appreciate those comments, as always, my good friend from Texas.

I always look back, from being in Vietnam in a prison camp and looking up there trying to see those satellites going over, and some of your friends were flying over during that time and have told me about it. They looked down at us, too, and I guess there was that electricity that went between us to let us know there were still Americans over here that cared.

That's what you're all about today, and we appreciate it. I think that since its inception NASA has been a driver of technology as well as a source of encouragement for the Nation and for our kids.

Mr. Chairman, in lieu of taking up a lot of time, I will just ask unanimous consent to enter this in the record, and I will just say thank you for being here, and thank you for being Americans.

Mr. HALL. Without objection, it will be admitted, and the Chair is pleased to recognize Mr. Butler.

STATEMENT OF DAMON BUTLER, STUDENT, SUMMER HIGH SCHOOL APPRENTICE RESEARCH PROGRAM, OXON HILL HIGH SCHOOL, MARYLAND

Mr. BUTLER. Thank you, Mr. Chairman and members of Congress and distinguished guests.

It is a distinct honor and great privilege to be seated here as part of the 3-D future of space and to talk with you about youth programs involving science and technology. I am delighted that the Congress of the United States has shown an interest in these programs and cares enough to listen to a representative of the youth of America, the group that will most certainly continue the progress and success of the space program throughout the 21st century.

I will begin by telling you a little about myself, how I have prepared for the future that awaits me, and how I have tried to stand out from my peers. A week ago last Tuesday, I walked across the stage at the Capital Centre as an 18 year- old graduate of the Science and Technology Center at Oxon Hill High School. This is a program designed for students with a special interest in math, science and technology.

During my short career, I have received many awards and commendations. Among the more notable achievements are: selection for the Summer High School Apprenticeship Research Program, better known as SHARP; membership in the Young Astronaut Program; Certificate of Recognition for Outstanding Achievement in Math; Certificate for completion of the Summer Enrichment Program for Talented and Gifted Students held at American University; attendance at Space Camp in Huntsville, Alabama; membership in both the National Honor Society and Kitty Hawk Air Society; recipient of the American Legion Award for Citizenship; and the Senator Komenda plaque for leadership.

I was also the Wing Commander over 307 cadets of Oxon Hill High School's Junior ROTC Honor Unit. After being recognized as Cadet of the Year in 1991 and 1992, I graduated with the rank of Cadet Colonel and received a Type II Air Force ROTC scholarship in mathematics. I am one of those students Mr. Smith spoke of that wanted to be the first man to set foot on Mars.

Our future is an opportunity. This is God's gift to us. What we make of it is our gift to Him. Therefore, I shall make a difference. My future is one that could not visualize for myself. I would not be able to see it at all if I were not standing on the peak of a pyramid. The pyramid of which I speak has God as my base, my family as the foundation, and the support of an invaluable education. I am the beneficiary of an insightful family that has made many opportunities, like the Young Astronaut and SHARP programs, available to me, and I have tried to make the most of them.

Approximately three years ago, as a member of the Young Astronaut program, I testified before a Senate subcommittee on Science and Technology, chaired by Senator Albert Gore. My testimony then involved the importance of recognizing and developing our youth programs, particularly those programs affiliated with math and science.

Today I come back with an even stronger desire and increased motivation for programs like SHARP to challenge our youth. Since I was last here, I spent the past two summers at the Goddard Space Flight Center in Greenbelt, Maryland, working under various mentors and in conjunction with other professionals in their particular field.

During my first summer, I worked in Code 500 of the Information Processing Division of the Mission Support Systems Branch under the direction of Tonjua Hines. This branch has two major responsibilities: first, the analysis, evaluation and development of computer systems, and second, improving methods of computer performance measurement and software engineering. My task was to develop a complete Local Area Network.

Last summer, I was introduced to the technological industry by working with engineers, specialists and other qualified personnel in the aerospace field. I was taught about management, quality assurance and safety by Janice Buckner, Mary Igal and Kathy Jenkins, respectively. Moreover, the efforts of my mentors were combined to formulate my summer research project on the role of quality assurance in environmental testing. My project specifically dealt with the quality assurance testing of TEMP 2A-3 and in particular the vibration test of the Temperature Control Module.

I have benefitted from all my experiences, but none more so than the SHARP experience. I have gained valuable leadership and technical skills along with hands-on experience. SHARP assignments have enhanced my sense of responsibility and my mentors have exposed me to the artful concept of networking. The experience gained from writing SHARP research papers will no doubt assist me in my future writing exploits. These are just some of the benefits I have derived from SHARP, but like anything else, you get out what you put in.

Success is not automatic. All SHARP participants who complete the program have gone on to college. Ninety-eight of these students have furthered their education by obtaining bachelor degrees from 48 different institutions. And to date, not a single one has dropped out. SHARP's perfect 100 percent graduation rate from college is sometimes attributed to the participants, when in fact,their success can be traced to two unsung heroes, Dr. Elva Bailey and Cyn Collier. Their design, development and implementation of the SHARP program deserves a lot of the credit. I think every participant has talent, but SHARP provides the opportunity to utilize that talent.

Congressman Sensenbrenner stated that we must continue to invest in the space program. An investment in the space program is an investment in education. We can all agree that the American space program provides excitement for children. In other words, these youth programs allow children to actively participate in, contribute to, and profit from the technological advances in the aerospace field.

In my psychology class, we learned about the changing trend in pre-school education from lecturing and reading to hands-on learning. It is much easier to learn when you are given practical applications. The SHARP program has already developed this trend by utilizing the hands-on approach to increase motivation in math, science and engineering.

Just recently I read an article questioning the validity of funding for our space programs. Mr. Chairman, not a single dime of the money allocated for these space programs is spent in space, but rather here on earth, in business, industry, technology and education. When I thought of NASA before, I tended to think of those instruments designed solely for space use. But many of those devices, like the microwave oven, for example, make our daily lives just a little easier.

Another article documented a young boy who could not regulate his body temperature, thereby forcing him to remain in a climate controlled environment. A space suit designed by NASA enabled him to go outside to play. There are so many things that we accomplish with space technology we sometimes forget the impact they have on us right here on earth.

In the book, A Testament of Hope, we find the words of Dr. Martin Luther King, Jr.: "Those of us who live in the 20th century are privileged to live in one of the most momentous periods of human history." The take-down of the Berlin Wall, the dissolution of the Soviet Republic, and the first landing of man on the moon are examples of this exciting age filled with hope.

The greatest technological undertaking in history culminated in 1969. Although the lunar landing mission happened before I was born, I have followed with great interest the impact of the space program on America's youth.

It is still unbelievable to me that I am seated next to a man who less than one month ago was hurling through space at an unfathomable rate of 17,000 miles per hour clinging to a 4- ton satellite. The image, still fresh in my mind, is breathtaking. Can you imagine the excitement he has generated for the millions that witnessed his phenomenal endeavor?

In conclusion, the Congress must be mindful of the youth programs and cognizant that young people have to continue the space program with renewed vision, drive and commitment. In fact, the success of our entire Nation depends on the youth of America and how well we are prepared for the future. In the words of John F. Kennedy, "The energy, the faith, and the devotion which we bring to this endeavor will light our country and all who serve it, and the glow from that fire can truly light the world."

Thank you.

[The prepared statement of Mr. Butler follows:]

TESTIMONY BY DAMON BUTLER BEFORE THE
U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON SPACE OF THE COMMITTEE
ON SCIENCE, SPACE, AND TECHNOLOGY
JUNE 10, 1992

SHARP TESTIMONY - JUNE 10, 1992

Good afternoon. My name is Damon Butler. It is a distinct honor and great privilege to be seated here part of the elite future of space and to talk with you about the youth programs involving science and technology. I am delighted that the Congress of the United States has shown an interest in these programs and cares enough to listen to a representative of the youth of America. The group that will most certainly continue the progress and success of the space program throughout the twenty-first century.

I will begin by telling you a little about myself, how I have prepared for the future that awaits me, and how I have tried to standout from my peers. A week ago last Tuesday, I walked across the stage at the Capital Centre as an 18 year-old graduate of the Science and Technology Center at Oxon Hill High School. This is a program designed for students with a special interest in math, science, and engineering. During my short career, I have received many awards and commendations. Among the more notable achievements are: selection for the Summer High School Apprenticeship Research Program (SHARP); membership in the Young Astronaut Program, Certificate of Recognition for Outstanding Achievement in Math; Certificate for completion of the Summer Enrichment Program for Talented and Gifted Students held at American University; Attendance at SpaceCamp in Huntsville, Alabama; membership in both the National Honor Society and Kittyhawk Air Society; Recipient of the American Legion Award for Citizenship and the Senator Komenda

Plaque. I was also the Wing Commander over 307 cadets of Oxon Hill High School's Junior ROTC Honor Unit. After being recognized as Cadet of the Year in 1991 and 1992, I graduated with the rank of Cadet Colonel and received a Type II Air Force ROTC scholarship in mathematics. Although I received hundreds of letters from colleges throughout the nation, I have decided to attend North Carolina State University's School of Engineering and Applied Sciences for the coming fall.

Our future is an opportunity. This is God's gift to us. What we make of it is our gift to HIM. Therefore, I shall make a difference. My future is one that I could not visualize for myself. I would not be able to see it at all, if I were not standing on the peak of a pyramid. The pyramid of which I speak has God as my base, my family as the foundation, and the support of an invaluable education. I am the beneficiary of an insightful family that has made many opportunities, like the Young Astronaut and SHARP Programs available to me and I have tried to make the most of them.

Approximately three years ago, as a member of the Young Astronaut Program, I testified before a Senate Subcommittee on Science and Technology chaired by Senator Albert Gore. My testimony then, involved the importance of recognizing and developing our youth programs; particularly those programs affiliated with math, science, and technology.

Today, I come with an even stronger desire and increased motivation for programs like SHARP to challenge our youth. Since I was last here, I have spent the past two summers at the Goddard Space Flight Center (GSFC) in Greenbelt, MD working under various mentors and in conjunction with other professionals in their particular field.

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Success is not automatic! All SHARP participants who complete the program have gone on to college. 98 of these students have furthered their education by obtaining Bachelor Degrees from 46 different institutions. And, to date, not a single one has dropped out. SHARP's perfect 100% graduation rate from college is sometimes attributed to the participants. When in fact, their success can be traced to two unsung heroes, Dr. Elva Bailey and Cyn Gosier. Their design, development, and implementation of the SHARP Program deserves a lot of the credit. I think every participant has talent and SHARP provides the opportunity to utilize that talent.

We can all agree the American Space Program provides excitement for all children. In other words, these youth programs allow children to actively participate in, contribute to, and

profit from the technological advances in the aerospace field. In my psychology class, we learned about the changing trend in pre-school education -- from lecturing and reading to hands-on teaching. It is much easier to learn when you are given practical applications. The SHARP Program has already developed this trend by utilizing the hands-on approach to increase motivation in math, science, and engineering.

Just recently, I read an article questioning the validity of funding for our space programs. Mr. Chairman, not a single dime of the money allocated for these programs is spent in space, but rather here on earth in business, industry, technology, and education. When I thought of NASA, I tended to think of those instruments designed solely for space use, but many of those devices, like the microwave oven, for example, make our daily lives just a little easier. Another article documented a young boy who could not regulate his body temperature thereby forcing him to remain in a climate controlled environment. A space suit designed by NASA enabled him to go outside to play. There are so many things that we accomplish with space technology we sometimes forget the impact they have on us right here on earth.

In the book, A Testament of Hope, we find the words of Dr. Martin Luther King, Jr.; "Those of us who live in the 20th century are privileged to live in one of the most momentous periods of human history." The take-down of the Berlin Wall, the dissolution

of the Soviet Republic, and the first landing of man on the moon are examples of this exciting age filled with hope. The greatest technological undertaking in history culminated in 1969. Although the lunar landing mission happened before I was born, I have followed with great interest the impact of the space program on America's youth. It is still unbelievable that I am seated next to a man who less than one month ago was hurling through space at an unfathomable rate of 17,000 miles per hour clinging to a 4 ton satellite. The image, still fresh in my mind, is breathtaking. I shook the very hand that was holding onto that satellite. Can you imagine the excitement that he has generated for the millions that witnessed his phenomenal "endeavor"?

In conclusion, the Congress must be mindful of the youth programs and cognizant that young people have to continue the space program with a renewed vision, drive, and commitment. In fact, the success of our nation depends on the youth of America and how well we are prepared for the future. In the words of John F. Kennedy, "The energy, the faith, and the devotion which we bring to this endeavor will light our country and all who serve it, and the glow from that fire can truly light the world."

Mr. HALL. That's very good, Damon, thank you.

When you see a fine young man like Damon, it's no accident. There are some parents that loved you and cared for you and nurtured you, and I think it would be worthwhile to have them stand, Mr. and Mrs. Butler, if they are present. I know you are not without pride.

[Applause.]

Mr. HALL. We are also pleased to have Captain Brandenstein's wife, Jane. Jane, where are you?

[Applause.]

Mr. HALL. I never saw an aviator that didn't have a pretty wife.

[Laughter.]

How NASA Attracts Students to Math & Science

Mr. HALL. We thank you very much for your testimony, and I think we are going to get to ask you a few questions.

Mr. Goldin, I will start out by tossing you an easy one to knock out of the park. Just briefly tell us how the NASA programs contribute to that thing you call the pursuit of excellence in education. And keep in mind that we do need youngsters to turn to science and to math, and that it is a tough pursuit, because it is not as sexy maybe as some other pursuit, or not as interesting. How do you attract them?

Mr. GOLDIN. I believe the key is the inspiration that they get from seeing success. As I talked about, the inspiration they get from seeing failure and then success, by the inspiration they get from seeing caring human beings that want to interact with them. We literally have thousands of NASA employees that don't just do it as part of their job, they do it because they care, and as volunteers, because they want to make America a better place. I put that as the number one success factor.

The second factor I would put into the success equation is the knowledge base we have. By working in space, we learn how to work better on earth. The key to the NASA team is teamwork. We work with our own employees, we work with universities, we work with contractors. And I believe working with international partners rounds out that equation. So the teamwork spirit gets handed over to the young people.

Finally, I also think it's very important in our society is a diversity in the society, race, sex, culture. And NASA strives very, very hard to have diversity in its work force in all regards, with regard to the makeup of the work force, with regard to the management of that work force, and with regard to the performance of the work. I think those are the key factors.

Mr. HALL. You surely see some things we have missed. Like most administrators, you will have a positive program that you will want to put into force, and there will be those who, because you appear to be abandoning one of our pet projects, that we will complain. You will hear some complaints.

Education is the answer to the problems in Los Angeles, to the problems on the streets of Washington, and I guess all over this country. Education and opportunity is what most people want. How can we reach—now, a young man like Damon, with the opportuni-

ty he has had, which is obviously above and beyond many other youngsters, and he certainly made the most of it, how do you reach the youngster that doesn't have that opportunity? How do you reach that woman that doesn't get the same chance that a man gets when they are at the starting line? What types of programs do you have in mind, if any, at this time, you may tell me you are working on that, and that's acceptable?

Mr. GOLDIN. Well, let me say we are working on it. But let me give a sketch of what's in my mind. I believe programs have to reach out. We just can't target and focus this area or that area. So the things we are talking about is working with our contractor team. There are roughly 24,000 NASA employees, and I believe 225,000 contractors. We spread across almost every state in the country. So it's a total NASA team that will participate. We have begun early studies on how we could not just have the NASA employees, but the entire NASA team and our university partners reach out. Now think of the power of that many people.

That's one of the issue we have.

Mr. HALL. We saw the power of that many people when they tried to cut out the space station about a year ago.

[Laughter.]

Mr. GOLDIN. You will see it again, sir.

CONGRESSIONAL ACTION TO CUT SPACE STATION FUNDING

Mr. HALL. Yes, and we are looking for it again.

Does it really disturb you to think that there will be a move in this Congress once again to totally cut out the space station, to pursue the space station? Isn't that alarming?

Mr. GOLDIN. It rips my heart out. I come from 30 years in the space business. I worked on robotic spacecraft the whole time then. And I have been exposed to the wonders of the human space flight in the two months I have been in office. I am absolutely convinced that if this Nation does not proceed with Space Station Freedom, we are giving up the future. We have made commitments to our international partners that are putting billions of dollars into that program because they see the vision. They understand where it's going. And I believe it's NASA's job to help America understand that.

But the life sciences, the material sciences, and most important, the number one reason to understand the interactions of the humans in the hostile space environment will allow us to reach out to the heavens and at the same time understand the physiology of the human body and reach back and give technology back to the earth.

It will be the first international research station in space. It will build a community and a constituency where people don't have to run an experiment, wait five years, get the results, wait another five years and run that experiment again. We cannot graduate people in our universities with Ph.D.s. if they have to wait 10 or 15 years to do it.

The space station will have permanent presence in space and we can run a continuum of experiments. It will be an unbelievably

positive impact on America. I can't think of the negative part. And I think America will see that, and they will understand it.

Mr. HALL. How about the negative part of the American people picking up the newspaper and reading "Congress Cancels Space Station," people who have no idea right now that it is in jeopardy?

Mr. GOLDIN. Well, let me tell you. There is the long term vision, and there is the near term impact. We have tens of thousands of jobs of people on the cutting edge of technology. For every dollar that NASA spends, there is about a $7 to $9 turnaround in our economy. Just think of the impact when we have jobs at stake and that will just eliminate that.

But that's not the most serious part. The most serious part is for young people like Damon right here, where is their future going to be if America, who takes only one quarter of 1 percent of our gross national product to invest in the future, walks away from that future?

Let me tell you, our international partners understand the importance of the space station, and our Japanese partners are working with us on a shuttle mission in September, the international materials lab. They are going to be doing materials processing in space. They understand.

Their Minister of Science and Technology has talked to me numerous times. He said "We only have two astronauts between now and the time the space station is going to fly to go up in space. Can't we have four astronauts in space?" The Europeans feel the same way. They just want to get out there, because they understand the future. But more than that, I think Americans understand the future. And they will not accept the cancellation of the space station.

Mr. HALL. I think my time has expired. I will recognize Mr. Packard.

A STUDENT'S PERSPECTIVE ON THE SPACE PROGRAM

Mr. PACKARD. I want to ask Damon a question or two about what you find in your schools and with your colleagues and peers in school that excites them? Not everyone gets excited about math and science, and certainly not everyone is into the space program. What do we need to do to challenge and turn our students on to want to continue and get a higher education and pursue some of the goals that NASA offers?

Mr. BUTLER. One thing that is very special in my school is special projects. I am in the science and technology program, and we have engineering foundations, electronics. These are not just reading and doing manuals. We are doing the projects.

In my energy class just two months ago, we built a power supply. We have special programs outside of school, like Odyssey of the Mind, and we do special projects and compete against other schools. We have mock trials, math teams. Oxon Hill is always rated in the top of the county. These programs excite my colleagues and me. These are the things that stimulate our interest toward doing better and achieving more.

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Availability of Programs to Interest All Student Groups

Mr. Packard. Are the schools finding projects that cover the entire spectrum of student interests? Obviously, you would be excited about engineering and science issues. Other students may not get turned on at all from those. Do our schools provide other, broad projects that interest them in some of the social programs, or some of the other programs that the kids might be involved in?

Mr. Butler. Yes, sir. One particular program that I can speak on from experience is the ROTC program. The ROTC program goes out into the community, we try and help middle school students, we try and help elementary school students, we go to the middle schools to tell them about life, what it's going to be like in high school. We go and tell them about the transition, the new decision making, the new freedoms.

Programs like ROTC, where we have drill, where it is really separate inside the school, we have our own, separate finances, we have our own administration, we have our own messages. The ROTC program is self-supporting. Programs like these, where the children are in control, are programs that excite the children.

Mr. Packard. You are in the gifted program. We often put our best programs and best teachers to stimulate and help those of our students. What about those that are in the less gifted, and sometimes even the handicapped programs? Do you have special programs that you see keeping pace with those students?

Mr. Butler. Yes, we have programs like that. I for one cannot speak on the handicapped programs at our school. I am not involved in them. But I am also a tutor on the side, and many of my colleagues in the National Honor Society tutor on the side, deliver groceries, help out in soup kitchens, we do many things in the community to try and bring everyone along.

Mr. Packard. Thank you very much.

Mr. Chairman, that's all I have.

Mr. Hall. The Chair recognizes Mr. Mineta.

SETI Educational Efforts

Mr. Mineta. Thank you very much, Mr. Chairman.

Mr. Goldin, the Search for Extraterrestrial Intelligence microwave observing project, it's proving to be a wonderful teaching tool, with in-kind and matching support from NASA, the National Science Foundation has provided a three-year, $700,000 grant to the SETI institute to develop innovative teaching materials for grades three through nine. Early trials of these materials, which are based on the multidisciplinary aspects of the story of life in the universe have been highly successful.

I believe this is exactly the kind of effort that will inspire children at an early age and produce an early interest in science and math education. I was wondering if you would care to comment on SETI's educational efforts.

Mr. Goldin. I think it's an excellent idea. You don't have to live in 1992 to wonder about what's in the heavens. If you go back to readings of the ancients, they all looked up to the stars and they looked up to the heavens with wonderment. Small children and old children have that same quest. So when we help children under-

stand the possibilities that are out in the universe, a program such as the SETI learning experience I think also provides us inspiration that I was talking about before. So I think it's a very positive influence.

Student Response to Astronauts

Mr. Mineta. Captain, the Astronaut Corps has several astronauts and candidates who speak to students of all ages. I am wondering if you might be able to relate what kind of response you get from the students who have been exposed to astronauts or astronaut candidates?

Captain Brandenstein. I think one of the—and we all speak to students and we all enjoy the opportunity. It's one of the public appearances that an astronaut enjoys the most, talking with the youth, because we recognize them to be the future, and enjoy their interest in the program.

Probably the best way to characterize it is by living example. Be they second or third graders, when you get up to speak, you can hear a pin drop. And when they are junior high to high school students, you come into an auditorium, and it's approaching chaos, but you get introduced, and you can hear a pin drop, and you can keep that attention span for an hour.

I think that is indicative of the interest that the students have in the space program. We always try and give time for questions and answers following a presentation. Generally they get cut off and run out of time before the questions are all answered. After that, you will find students following you down the hall asking you questions, all the way out to the car.

So the interest is phenomenal. Comparing it back to when I was in that age group, the level of education is phenomenal. Because if I was selected to be an astronaut today I probably wouldn't make it, because of the level the education has come to in this country. I'm real glad and feel lucky that I got selected back in 1978 and am not competing with the candidates of today.

Mr. Mineta. With Damon.

Captain Brandenstein. That's right.

[Laughter.]

Mr. Hall. You ought to be glad you don't have to run every two years.

[Laughter.]

Mr. Mineta. Damon, I see that you are going to be attending North Carolina State in the fall. Given your tremendous background and the exposure you have had to all the various programs, including SHARP, what would you like to do in terms of your own future with your engineering and applied sciences major?

Mr. Butler. My first choice would be to be an astronaut, and my second choice would be to have Mr. Goldin's job.

[Laughter.]

Mr. Goldin. I may have to run, too, Mr. Hall.

Mr. Mineta. Mr. Chairman, is this a confirmation hearing?

[Laughter.]

Mr. Hall. Captain Brandenstein is just about to take Mr. Sensenbrenner's place. Maybe we can all cut a deal with you three.

[Laughter.]

Mr. MINETA. Again let me express my thanks to the Administrator, the Captain and Damon. Hopefully later on they will have the opportunity—I know, Captain Brandenstein and the Administrator will be at our Space Caucus. I hope, Damon, you will have a chance to stay later on for our space caucus, one that I have the privilege of co-chairing with Congressman Herb Bateman.

So we will be having some activities later on in the afternoon here in the cafeteria of the Rayburn Building. I hope you will be able to join us.

Thank you very much, Mr. Chairman.

Mr. HALL. We will have other questions for you. Obviously, the members who are not in attendance, who are in other committee hearings, and are on the floor debating the balanced budget amendment will have questions. If it's all right with the three of you, we will submit some to you in writing and ask you to answer them, giving you a decent length of time.

It seemed like I wanted to ask the Administrator about something. I wrote a letter to Admiral Truly back in November regarding the fact that the press had reported that NASA had raised the price for the getaway special payloads on the shuttle payloads by over 100 percent. That provided low cost flight opportunities for students and others aboard the space shuttle. Has that come to your attention?

Mr. GOLDIN. It has not, but it got my attention with the mention of it, and sir, I will look into it, and get right back to you.

Mr. HALL. It seems at a time when we are trying to encourage the Damon Butlers of the world and our high school and college students to develop some interest in science and space technology that that's kind of a bad move.

Mr. GOLDIN. We will go work on that problem.

Mr. HALL. I may as well be brutally blunt, we are just damned well against it.

[Laughter.]

Mr. GOLDIN. I got the message, sir.

Mr. HALL. Well, I tell you, I think we are going to have some good experiences with you. I have read and studied and I have heard some of your speeches. I think you are the right guy at the right time, and this committee is certainly looking forward to your leadership. We thank you for appearing here today.

Captain, thanks again. I will be in Houston Monday with this subcommittee to pursue the biomedical thrust. We will take hearings there. I don't know if you will be there then, but if so, I know the committee would be pleased to see you again.

And Damon, thank you. You are fine young man, and we need 100 million just like you.

Mr. BUTLER. Thank you, sir.

Mr. HALL. Keep up the good work, and don't ever lose sight of your goal, and God bless you. We thank this panel.

If I can have your attention, I understand we have the entire crew of the Endeavour outside. Captain, why don't you have them come in and we will recognize them?

Captain BRANDENSTEIN. I'd be happy to.

Mr. HALL. I see Lynn Henninger in the audience there. Lynn, we thank you for the help you extended to use during our visits to the three areas.

The Chair recognizes the Captain.

Captain BRANDENSTEIN. I don't believe we have the whole crew, but we have a good portion of it. We have Kathy Thornton, who was one of the mission specialists for the EVA, and was a backup arm operator, and laser operator, camera operator and a variety of other things. We all tend to be multi-talented.

Pierre Thuot, who did three of the spacewalks and made the attempts to grab the satellite with the capture bar which proved to be unsuccessful and was part of the team that ultimately grabbed it by hand.

Mr. HALL. Was he the one that kind of filibustered it until you got on prime time?

[Laughter.]

Captain BRANDENSTEIN. We have been accused of that, but we would much rather have had it go perfectly the first try.

Next to him is Kevin Chilton. He was the only rookie on this flight, it was his first flight. He was the pilot. He was my backup on all the rendezvous operations and the proximity operations. He was backup arm operator and a variety of other tasks.

And Bruce Melnick from the Coast Guard was the mechanical arm operator. He was the prime arm operator throughout all the various rescue attempts, and did a bang-up job.

The folks who aren't here are Tom Akers and Rick Hieb, both of whom were out on the space walk with Pierre that did the final capture of the satellite.

Mr. HALL. It's an honor to have you. This committee, this subcommittee and this Congress are very grateful to you. Thank you.

[Applause.]

Mr. HALL. Now we want to certainly welcome you. You are our educators and certainly part of the one, two, three punch that we hope we get out of this hearing today. I could but say a personal word to you, all of my family are educators.

My only sister is a teacher and she is just finishing at Tarleton State University after 30 years. My only wife is a teacher, my only mother was a teacher, and I was a school superintendent at one time.

So we had a lot of common schools before they built farm- to-market roads to get them into the schools, and before the states had passed legislation that set up a little better system of education for us, particularly as that was state to state.

We are honored to have you folks today. You have been selected—we didn't just draw your names out of a hat—you have been selected because of your success and in recognition of your success and your dedication. I think that's evidenced by the fact that you are willing to come here today, and preparation and travel for you takes some time. On behalf of the committee, I certainly want to thank you for that.

We have Mr. Wendell Mohling, who is President of the National Science Teachers Association; Ms. Relzie M. Payton, who is the President of the Tennessee Education Association, and National

Education Association. Does that mean you are president of the NEA?

Ms. PAYTON. We are an affiliate.

Mr. HALL. Okay.

Ms. PAYTON. We are the eighth largest affiliate.

Mr. HALL. You are Tennessee's—

Ms. PAYTON. Right. Each state has a president.

Mr. HALL. Okay, good. Like I told you before, if it hadn't been for Tennessee, there wouldn't be a Texas. Tennessee and Kentucky.

Ms. PAYTON. I love you for two reasons now.

Mr. HALL. What is the other one?

Ms. PAYTON. Your education background.

[Laughter.]

Mr. HALL. You bet.

And Mrs. Nancy McIntyre, Director of Educational Center for Earth Observation Systems at West Chester University in Pennsylvania. Is Congressman Walker here? Mr. Rohrabacher, we want to recognize you for an opening statement. But I believe Mr. Walker had been the one, Mrs. McIntyre, that suggested you be here.

Mrs. MCINTYRE. He is on the floor right now, and wants to stop by.

Mr. HALL. He is on the floor all the time. Were you in school with him?

Mrs. MCINTYRE. No, I live in his district, and he has spoken at our conferences. So he knows what West Chester is doing.

Mr. HALL. Good. He is a very valuable member of Congress, and I know you folks know that.

The Chair will recognize Mr. Rohrabacher, and I have never seen him without something to say. He has probably been on the floor.

Mr. ROHRABACHER. This is a monumental day. As you know, we are talking about the balanced budget amendment. And when Congress starts discussing the balanced budget amendment, what we are really talking about is the ability of Congress to set priorities. And what are the priorities for America, when you have a limited number of funds, what can you do with them?

Today, we are discussing here in this hearing something that I believe is of great value to the United States of America, and that is the relationship between education and America's science program and space program. In my community in Southern California, for example, we have a magnet school in the Long Beach area which has the support of our local aerospace firms, and we have young people who work on computers that have been donated by the local aerospace firms.

Some of the lessons they are taught are brought in to them by the engineers at the science programs and the aerospace firms nearby, Rockwell, and of course in Huntington Beach we have McDonnell Douglas. It's so important to our economy that we have these local firms healthy and growing in our local economy. But it's also important to our local education system that there be students prepared for those jobs.

So there is an interaction in my local area, and I'm sorry that unfortunately you have come here on this day when we are all so focused on this floor debate. But I am very interested in not only

staying for the whole hearing, but also reading the testimony today.

I appreciate you, Mr. Chairman, carrying it on for the rest of us who are going back and forth to this debate. Thank you very much.

Mr. HALL. The Chair will recognize Mr. Mohling, if you want to start. If you three have made any arrangements among yourselves as to who speaks first, second or third, we will honor that. We have your statement, and without objection, your statement will be made a part of the record, and you may either speak from the statement or just brief your statement.

The Chair recognizes you, Mr. Mohling, at this time.

STATEMENT OF WENDELL G. MOHLING, PRESIDENT, NATIONAL SCIENCE TEACHERS ASSOCIATION, SHAWNEE MISSION, KANSAS

Mr. MOHLING. Thank you very much.

I want to say that it's a real honor to be here, Mr. Chairman, and members of the committee, and distinguished guests, because it's an opportunity for me to share my experiences as a teacher and also as a representative of the National Science Teachers Association as the current president.

But more than any of those, I think that my real purpose today in being here is to come as a cheerleader. I left the pom poms and megaphone at home, but I really want to tell you from the bottom of my heart that as a cheerleader of the space programs and the many things it has offered, I have been one of the major benefactors of many of these programs, as a science teacher and as a science student, and as a community involved person in my area.

NASA and the space environment that has been provided through the NASA explorations and through the support of Congress and the American public has provided the inspiration for students and teachers for a long, long time. I want to emphasize several things in my presentation today.

In fact, I have to thank the space program, although it's not the U.S. program, for my role as a science teacher. Because I was in high school at the time the Russians launched Sputnik. I was a poor kid from the farm area of Nebraska, and I was a little bit unsure about how I was going to make it through college.

Fortunately, as a result of that Russian exploration, there was a keen awareness in this country of the need to focus on education, in particular science education, many loan programs became available to teachers like myself in an opportunity to be trained with some support funds.

But we learned a lot in those early days of the space program, and I know that when President Kennedy set his goal for the Nation to reach the moon by the end of the decade of the 1960s, it also created a model for the students who were in our classrooms to aim high, study much, work hard and also feel good about success. We enjoyed the successes, the countless successes of our space program over the years.

As a classroom teacher, my theme has always been to teach from an environmental perspective, and space provided that extra support to look at the earth from space. I don't think that I could ever tell anyone what it felt like to me to see the pictures of the early

astronauts brought back to us on the earth from space, looking at our planet, looking at our own spaceship. I certainly know that through their eyes, we were all increased in value in terms of our perspective of our planet.

So today, from the techniques and tools provided for the space program, there is a lot more opportunity for me to do a better job in my classroom. A couple of summers ago, I spent time at Eastern Michigan University learning to establish a direct readout station which allows students in schools to utilize space technology to look at the earth, primarily looking at weather data and so forth.

We have the first direct readout station that we established in our high school in Kansas. Students can have real-time access to those images from space. That provides them with some insight into what they might choose as their career. Now, they certainly aren't using the highest resolution kinds of pictures, but they at least can establish and understand the kinds of techniques, and also can learn about the possible impact that these images would have for future careers that they might be involved in.

Another perspective that I bring is that I really received a boost in my own involvement in science education when I was a finalist for the Teacher in Space program. I applied for that, and I learned a lot about that process. In fact, when I go out and do presentations to schools, I always give them basically four lessons that I want them to come away with, four things to learn.

One of those is called Do Your Homework, and of course they can relate to that. But if it hadn't been for me finishing my homework, that application for the Teacher in Space program, I would never have had the number of opportunities that I have had over the last couple of years.

As I have had a chance to speak from a Teacher in Space perspective, I always remember the application form asking a question about a project. My project was entitled "From One- Room school to One-Earth Classroom." I constantly remind myself that my first eight grades were in a one-room classroom in Nebraska, and now in the same lifetime as a teacher, there are opportunities for teachers to teach the entire earth at one time.

We have made some real giant leaps, and sometimes I think we forget that. We are so caught up in the fast-paced mode of our current lifestyle that we need to be reminded of such a short history and what a giant leap we have made.

I even am reminded sometimes of the "nos' that we had in school, "nos" in terms of "Don't dream in school." Another no was "Don't make paper airplanes in school." Now I go out and teach just the opposite. I want my students to dream, and I want them also to build paper airplanes.

In fact, yesterday, I spent time with 45 teachers of the Native American Schools around the country in a summer workshop at the University of Kansas and they were making shuttles out of cookie trays, and making paper airplanes. Today they are making model rockets and hot air balloons and I have to get back home tomorrow in time for launch day.

So we have a lot of workshops and teachers are getting very involved and using space as themes. We have a lot of tools which we can share and help them with that. This helps them to develop not

only good teaching strategies and practice, but also give them the content materials that they need for support in their own classrooms. In addition to those programs, I am involved as a national faculty member in the Challenger programs. We sponsor a number of workshops for teachers, the Touching the Future programs.

Also, Marsville—this spring we had the first Marsville in Kansas. In fact, it was Marsville at Wellsville, Kansas. We brought teachers together and students together from a number of schools, and they had a most exciting time putting together plastic bubbles to simulate a Martian city and dwelling. It provided an opportunity for me to share back with other teachers, sort of a payback, some of the lessons I had learned.

So all of us in the Teacher in Space program I think realize that that was a catalyst for us to energize a number of other teachers. I have done thousands of programs and presentations with people across the country, and I know the other space ambassadors have done likewise.

From the NSTA perspective, we have long had a good partnership with NASA. We sponsor with NASA the NEWMAST and NEWEST workshops in the summertime for the teachers, and the SSIP programs. Those 1,800 teachers, in fact the ones selected for this summer represent 48 states, and some of them are already at Johnson Space Center and other locations involved in those workshops. I was also a former participant in a NEWMAST workshop. They provide teachers with excellent programs content and some leadership.

The thing I want to really emphasize today is that the NASA educational affairs staff and the people involved in education at NASA are real leaders. They are not just a support team that helps sponsor workshops and helps teachers out. But I learned a lot of key things. My first introduction to a video disk was from a Space Mobiler.

As I watch and work with my colleagues in the NASA educational affairs office, I am constantly reminded of their dedication to being on the leading edge. I am involved right now on the national standards development for science teaching. I am already getting inquires from my NASA friends who are saying "What's the latest status? When are the standards going to come out?" They want to help with that.

Our NSTA is involved in a content core, looking at scope sequence and coordination. NASA educators are involved in learning it at the same time. Their workshops are focused on being leading, key, skilled educators, because they know they are going to be leading the way for many, many other teachers.

So I want to emphasize repeatedly that NASA is a good cooperator and is seen that way by many teachers. I'm wearing a button today that says "I asked an Astronomer." These buttons were given out at a recent Boston convention. We had 18,000 science teachers in Boston, and many of them, perhaps all 18,000, stopped by the NASA set of exhibits.

We had scientists there, NASA had sponsored an astronomer booth. There was an astronomer there, and any teacher who had a question about astronomy could go up and ask it. They got rewarded with a button. I know a lot of teachers really enjoyed that op-

portunity to rub shoulders with scientists, the cutting edge of people in the field.

We are already finding partnership activities for video conferences and so forth at our next NSTA convention in Kansas City.

Dr. Goldin reviewed a number of the programs and also Captain Brandenstein reviewed a number of the programs that NSTA and NASA and science educators are involved in, so I won't review those.

But let me close by adding a few comments, and perhaps this will emphasize some of the things that have been said earlier. Space exploration is a human endeavor. I grew up in a rural area of Nebraska, just a few miles from the Oregon Trail. I remember my fourth through eighth grade teacher, because I had the same one all those years, taking us on field trips ever year to see the ruts from the wagons from the Oregon Trail days.

Today where I teach I am only a few miles from where the Santa Fe Trail and the Oregon Trail separated, in Kansas. I share with my students a similar heritage of the Plains that I received. A twinge of emotion is shared as stores are told of the struggle of the pioneers on these trails. Students are reminded of the countless problems that were encountered and share in the successes achieved over seemingly insurmountable obstacles. They gain insight and inspiration and they share dreams with their ancestors.

The recent Endeavour mission piqued our interest and excitement as we shared a similar pioneer drama. Each day we were drawn to the drama as we vicariously shared our dreams of the capture and repair of a satellite in space. The wagons of today are different, the trail bosses have new tools and techniques, and the drama is portrayed on a much different stage.

However, the similarity of the human experience is remarkable. Our lives are closely entwined with both present day and historical pioneers. We are drawn to the human drive to explore, to experience the unknown. The Oregon and Santa Fe Trails would have long ago been forgotten if only unpeopled wagons would have traveled the course.

As teachers, we share the dreams of our students. We feel the exhilaration when we witness achievement of those dreams by our students. We sense the importance of continuing to dream when situations become impossible. My most important role as a teacher is to help my students to dream. Dream making is an important task.

NASA, the Endeavour crew, members of this committee, Congress, the American public and anyone else who has helped us to share our interest in space, I want to thank all of you for helping make my job as a dream maker to students so easy. I think that space and space exploration really helps students to have a vision.

Thank you.

[The prepared statement of Mr. Mohling follows:]

TESTIMONY PROVIDED TO THE UNITED STATES HOUSE OF REPRESENTATIVES SUBCOMMITTEE ON SPACE

BY WENDELL G. MOHLING, PRESIDENT

NATIONAL SCIENCE TEACHERS ASSOCIATION

JUNE 10, 1992

My name is Wendell G. Mohling, and I reside at 4920 Widmer, Shawnee Mission, KS 66216. I have been a science teacher for the past twenty seven years and am currently the President of the National Science Teachers Association (NSTA). The Association is comprised of 50,000 members, including preschool through university science educators.

I have been a teacher in the Shawnee Mission Public Schools in Shawnee Mission, KS for the past 24 years and have served as a Biology, Student Naturalist, and Environmental Science instructor for the past 20 years at Shawnee Mission Northwest High School, 12701 West 67th St. Shawnee Mission, KS.

My interest and imagination in space had its focus while I was a high school student, and the Russians launched "Sputnik". I have been captivated by the space program ever since and found the theme of space to be a useful tool for motivation in my classroom since the

beginning of my career as a teacher. My first ninth grade General Science classes in Scribner Nebraska maintained a bulletin board time line with every known satellite and space craft launching recorded. Today, that list would be very long!

My interest in space continued to develop over the years and was stimulated by the feedback and interest demonstrated by my students. The challenge provided by President John Kennedy in his goal for the nation to reach the moon in the decade of the 60's created a model of goal setting for students. Aim high, study much, work hard, and feel good! Student goals paralleled the nation's effort to achieve space age success.

The thrill of success of our country in reaching the lofty goal of the moon on July 20, 1969 was shared by many of my students. I also felt some satisfaction knowing that through their involvement in science classes they also understood more of the scientific and technological impacts of the endeavor and could therefore more fully appreciate this achievement. Underscoring the "giant leap" forward that was encapsulated by the Apollo XI landing and return,

students in my classes today are in awe as the historical achievement of over two decades ago is reviewed. If we left on a voyage to the moon tomorrow, it would still be considered a "leading edge" activity.

My interest in using space science as a theme continued during my teaching career. I became very active in environmental education and frequently used the views from space provided by human spacecraft as well as from Landsat and other satellites. Using the platform of space in the analysis of the earth was a logical next step for me and for my students. Having a space station and other permanent laboratories from which to view our planet would provide the essential data stream for environmental decision making.

Two years ago I spent time in the summer receiving training on how to set up and operate a Direct Readout Station in a NASA supported program at Eastern Michigan University. Upon returning home, I was able to develop a business school partnership with the Kansas City Power and Light Company. With their assistance and with funds raised by the students from a plant sale, we established the first Direct Readout Station for a high school in Kansas, capable of receiving data from both

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polar orbiting and geosynchronous satellites. The excitement of students in utilizing real time images cannot be overemphasized. Weather fronts and associated activities are obviously reinforced concepts. In addition, geography lessons are frequently learned and the atlas is kept close by for reference. Although the data received in this manner is not the highest resolution available, the introduction to, and practice with this system provides my students with insight to future careers in remote sensing, cartography and related fields.

My interest in environmental and space education received a boost when I applied for, and was accepted as a finalist in the NASA Teacher in Space Program. This program provided for an incredible amount of enthusiasm among teachers and students. If such a program were initiated today, the application numbers would soar far beyond the 40,000 requested a few years ago. The related teaching activities made available as well as the more intensified focus on space education provided more teachers with the tools and the motivation to incorporate space themes into the classroom.

"From One Room School to One Earth Classroom" was the title of the project that I had proposed as part of my application for the Teacher in Space Program. The fact that during my lifetime it was possible to go from receiving the first eight grades of education in a one room school setting in rural Nebraska to having an opportunity to teach a "One Earth Classroom" from the space shuttle is incredible.

Although I was not selected as the Teacher in Space, I am confident that I share the feelings of my fellow finalists in that program that it was most successful in the long term benefits to teachers and students. I am sandwiching this testimony in between a teacher workshop for 45 teachers of Native American students being held at the University of Kansas and 25 elementary teachers from rural schools, in a workshop for the Greenbush Kansas Consortium and Pittsburg State University in Southeast Kansas. "Touching the Future" and "Marsville" workshops presented by those of us on the National Faculty of the Challenger Center and numerous presentations to schools and civic organizations around the country continue as daily offerings from the team of volunteer NASA Space

Ambassadors. My motivation for my intensive involvement in presenting the numerous workshops and programs over the past six years is simple. This is my opportunity to "pay back" to my profession for the many experiences made available to me.

The leadership demonstrated by the NASA Education Division is recognized by my colleagues around the country. Approximately 10 applications were received for each opening in this years' offering of NEWMAST (NASA Education Workshop for Mathematics and Science Teachers) and NEWEST (NASA Education Workshop for Elementary School Teachers). From personal experience, and from visiting with some of the 1800 teachers who have been part of these workshops over the past nine years, these two week workshops set a standard of excellence by providing teachers a meaningful summer training program. We, at NSTA, are most pleased with the ongoing relationship that we have had in the sponsorship of these quality programs for teachers. The diversity of participation is noted in the representation of 48 states in this summer's program.

Information from these workshops and other sponsored NASA educational events, such as launch and

landing conferences, provide classroom teachers with curriculum ideas and materials. A genuine effort is made by every NASA Center and Educator to provide excellent service to teachers. Teachers become very excited when they have resources available to assist in their presentations, and the NASA Educational Affairs Division is always up to the task.

As a science teacher, and as a representative of my association, I also want to emphasize the quality of the delivery system by the NASA team of educators. They are not satisfied to just use the excellent resources, they seek the methods and appropriate pedagogy to demonstrate skilled teaching. In recent meetings with NASA staff I was confronted with a number of inquiries related to the development of National Standards in Science Education. I serve on the oversight committee of this effort and was pleased to find out the interest that NASA Educators had in this process. They've ordered copies of the recent publication, The Content Core, and have their own workshops to keep on the leading edge. I am proud to have them as science teaching colleagues!

Today I am wearing a button, "I Asked An

Astronomer", it says. These buttons were handed out at a NASA exhibit at our recent NSTA National Convention in Boston. This, and other exhibits provided an opportunity for teachers to "rub shoulders" with scientists. Many positive comments were received about this service. This enthusiasm is contagious and I know that many teachers went home from the convention ready to share new knowledge gained with their students.

Many other accolades can be directed to the Educational Affairs Division of NASA, to the fine student competitions made available through the SSIP (Student Space Involvement Project) programs, to the placement of educational services directly with the Astronaut Office for the continued "teaching from space" programs, and to the many fine exhibits, speakers, workshops, and educational materials made available to students, teachers, and the communities at large. That these programs are all received so enthusiastically by the educational community is testimony to the value and integrity of space education.

Space exploration is a human endeavor. I grew up in a rural area of Nebraska that was only a few miles

from the Oregon Trail, and I remember school day field trips to see the wagon ruts in the prairie. Today I teach only a few miles from where the Santa Fe and Oregon Trails separated in Kansas, and I share with my students a similar heritage of the plains. A twinge of emotion is shared as stories are told of the struggle of the pioneers on these trails. Students are reminded of the countless problems that were encountered and share in the successes achieved over seemingly insurmountable obstacles. They gain insight and inspiration. They share dreams with their ancestors.

The recent Endeavour mission piqued our interest and excitement as we shared a similar pioneer drama. Each day we were drawn to the drama as we vicariously shared our dreams of the capture and repair of a satellite in space. The wagons of today are different, the "trailbosses" have new tools and techniques, and the drama is portrayed on a much different stage. However, the similarity of the human experience is remarkable. Our lives are closely entwined with both present day and historical pioneers. We are drawn to the human drive to explore, to experience the unknown. The Oregon and Santa Fe Trails would have long ago been

forgotten if only "unpeopled" wagons traveled the course.

We share the dreams of others. We feel the exhilaration when we witness achievement of dreams. We sense the importance of continuing to dream when situations shout "impossible!"

My most important role as a teacher is to help my students to dream. Dream making is an important task. NASA, the Endeavour crew, and all of those of you who share our interest in space, I want to Thank You for making my job as "dream-maker" so easy!

Mr. HALL. Very well said.
Ms. Payton?

STATEMENT OF RELZIE M. PAYTON, PRESIDENT, TENNESSEE EDUCATION ASSOCIATION, NASHVILLE, TENNESSEE

Ms. PAYTON. Thank you, Mr. Chairman.

I am here representing 46,000 teachers in Tennessee, and 860,000 students. I want you to know, as well as this committee, that we are very proud of the fact that we have what we call Tennessee Space Week. This particular endeavor was conceived in 1986, and I don't need to remind anybody of what happened to that concept.

Tennessee Space Week has three main goals: first, to memorialize Challenger crew member and professional educator Christa McAuliffe, and to continue her mission to stimulate students' interest in learning from aerospace education; and second, to utilize space, the last great frontier, as an inspirational teaching tool in all Tennessee public school academic disciplines, and three, to place a special emphasis on aerospace education as it relates to mathematics and science.

The motto for Tennessee Space Week is "An Adventure in Education," and that's exactly what it has been, an adventure. The adventure for us in Tennessee began in June of 1986, when we, the teachers of the state, through our education association, wrote a letter to then-NASA Administrator James C. Fletcher outlining what we suspected would be viewed as a fairly outrageous proposal to jointly sponsor a statewide instructional project to commemorate the first anniversary of the Challenger accident.

At a time when criticism and accusations were being leveled at the Nation's space agency from every corner, surely, we thought, the last thing NASA administrators want to hear is an untried idea about an instructional program dreamed up by a bunch of space-happy teachers in Tennessee. Well, I'm here to tell you today that we were wrong.

Currently entering its seventh year, Tennessee Space Week, now jointly sponsored by the Tennessee Education Association, NASA and U.S. Space Camp, has become one of the largest, most successful and innovative aerospace education programs in existence. Where we once received inquiries and requests for our materials from other states, we now receive requests from all over the world.

From the first meeting, when TEA and NASA representatives sat around the table and dreamed of the possible and the impossible, NASA has been a valued partner in the Tennessee Space Week effort. Tennessee Space Week has evolved into a dynamic and exciting annual project anticipated by students and teachers alike.

In the packets that I have provided for each of the committee members, I have given a list of the components of that particular program. Many of the components have already been mentioned, but let me go back through them, because if I don't mention them, the 46,000 teachers will be upset.

There are eight major components of the Tennessee Space Week. There is a 200 plus page Tennessee Space Lesson Plan booklet with aerospace lesson plans in everything from rocketry science to home

economics and physical education. There are teacher training workshops conducted by NASA Aerospace Education Specialists.

We have student assembly programs complete with space suits and moon rocks, conducted by NASA Aerospace Education Specialists. We have a Tennessee Space Week Speakers Bureau of NASA experts and other aerospace industry experts who visit our schools to lecture.

We have academic contests such as space shuttle throws, space trivia, I Want To Be A Space Cadet, Star Trek Adventure, and Beam Me Up contests, replete with prizes of scholarships to attend U.S. Space Camp, field trips to the U.S. Space Camp and rocket center, cast jackets from Paramount Pictures TV series Star Trek: The Next Generation, or official Tennessee Space Week t-shirts and ball caps, of which you have one in your packet, and I would appreciate it if you would wear it one day.

Then we have as one of the components a special issue of the Tennessee Education Association Tennessee Teacher magazine, that is filled with lesson plans, class activities, and background articles for teachers on space exploration. An important component I believe in this program is that we have TV sponsorship of the Tennessee Space Week, which includes devoting a portion of the nightly local newscast to current aerospace topics. This is a thing that really excites the teachers in the State of Tennessee.

Then we have Tennessee Space Week Teachers' Camp, as has already been mentioned, which emphasizes aerospace education curriculum, and helps prepare teachers to take on the responsibility of coordinating the Tennessee Space Week in their local system.

All of this—and I want everybody to hear this—all of this is administered and financed by the teachers themselves through the auspices of their professional association, the Tennessee Education Association. Other than a one-time $1,500 contribution from the College of Education at UT Knoxville which was used to purchase paper, no funds or materials or personnel has ever been contributed toward this effort by either the state or Federal department of education. I make mention of that fact because we have dedicated teachers in the State of Tennessee as we have across this Nation.

Additionally, NASA and the U.S. Space Camp partners in this project provide no fund. Instead, they contribute materials, manpower and expertise to the project.

Let me conclude by going to the three important questions that were posed by this committee. Why is the space program important to educators? Generally speaking, it is important because it expands our knowledge of the universe and addresses the eternal human quest to know and understand.

As you know, knowledge and understanding is what education and educators are all about. The space program provides educators with an incredibly valuable tool, a key to our students' curiosity and imagination. The space program offers solid evidence why we as a Nation should never lose sight of the value of quality education. Just look what educated people, such as those in our U.S. space program, have accomplished.

More specifically, the relationship of the space program to education is closely tied to the relationship between the process of educating and the act of exploring. In the first instance, the object is

to impart or acquire general knowledge and develop powers of reasoning and judgment. In the second instance, the object is to investigate closely and to examine and determine the possibilities. From its inception, our space program has embraced both of these objectives. And in doing so, it became an integral part of the education of all Americans.

While our children struggle to learn reasoning skills in their classrooms each day, so that they may more thoroughly explore the possibilities in their world, NASA and other space-related agencies struggle to expand the boundaries of knowledge of the scientific community about the parts of the world that we consider celestial.

What we have learned, however, since the beginning of our space program, is that knowledge gained through today's experiments become the substance of general knowledge to be imparted in the classrooms. Reasoning skills that are learned by school-age boys and girls today become the basis for scientific investigations of tomorrow's scientists and the beneficiaries of the results of that experimentation and investigation. Without the experimentation and investigations of the space program of the past 30 years, stimulation or rigorous scientific study in public schools would have been at best mundane.

Then the second question, how do humans and space and scientific space projects stimulate students' interest? Because students are human beings, and human beings are curious. We all want to know that which we do not know, and try that which we have never done. If all this natural curiosity weren't enough, we Americans come from pioneering stock. We are born explorers. Space and the U.S. space program provide a perfect instructional opportunity for teachers to turn these attributes to advantage in the classroom.

How do NASA's educational programs assist the educational community? The teacher workshops, assembly programs and teacher camps that I mentioned earlier are all part of NASA's existing education program. NASA easily adapted them to fit the particular needs of the Tennessee Space Week, and we appreciate that.

With the current level of deplorably limited funding for staff development in the State of Tennessee and other states, the teacher workshops and teachers camps are of particular benefit for those of us in the classroom. Teachers that attend these functions come away recharged with ideas and enthusiasm, as well as their arms laden with materials they can reproduce for classroom use.

Also of great benefit was NASA's guidance. From day one, the NASA education staff was available to us in Tennessee, and provided the practical guidance and assistance necessary to launch this project. Furthermore, they didn't desert us, and I will say that because our legislature did last year. They remained available at every step along the way to nurture, to train and to provide expertise whenever needed.

We might still have a Tennessee Space Week project without NASA if they had turned us down during our request. But it would never have become what it is today without NASA's enthusiastic participation.

Thank you.

[The prepared statement of Ms. Payton follows:]

Hold for release until presented by witness 6/10/1992, 1:30 p.m. EST

Statement of
Relzie Payton
President—Tennessee Education Association

before the
Subcommittee on Space
Committee on Science, Space and Technology
United States House of Representatives

June 10, 1992

Mr. Chairman and Members of the Committee:

My name is Relzie Payton and I am the president of the Tennessee Education Association, a professional organization with some 42,000 educator members and the eighth largest affiliate of the National Education Association. Thank-you for inviting me here today to give testimony regarding Aerospace Education, NASA's involvement in education, and the U.S. Space Program's role in stimulating interest in math and science among today's students. I will make my comments within the context of my, and my Association's, direct experience with NASA's Department of Education through a statewide Aerospace Education project — Tennessee Space Week.

In today's American classrooms the majority of the teaching corps is from the 30- or 40-something generation. Many of us were still school children and others were just embarking on teaching careers when the U.S. space program took its first fledgling steps and we watched in wide-eyed awe at its daring and wondrous accomplishments.

We could name the Mercury astronauts in the blink of an eye. We were glued to the snowy screens of our black and white television sets in nervous anticipation at every Gemini launch and splashdown. And on July 20, 1969, when Apollo 11's Lunar Lander touched down in the Sea of Tranquility on Earth's only natural satellite — the Moon — our hearts pounded with pride.

We were watching the birth of a new expedition of humankind. Each astronaut was a modern-day Columbus, each space vessel a 20th century schooner. Before our eyes, unfolded the ultimate drama — the demolition of man's horizons. We were no longer confined to Earth. Once again, we were going exploring.

Why is it that human beings so love to explore? It's because we are innately curious critters. We want to know what's in the hole — so we stick a finger in it...just ask any three-year-old. John Kennedy and the American people wanted to know what was on the moon, so we sent Neil Armstrong and Buzz Aldrin to find out. And today's ultimate mystery is: *Is there anybody else out there?*

Thank God for our human curiosity. It is a teacher's greatest ally. A teacher who can tap into a child's natural curiosity and kick the imagination into gear is assured of success — that child WILL learn! And so, recalling our own childhood fascination with space, teachers in Tennessee and across the world were thrilled to learn that Christa McAuliffe was going on the ultimate field trip and she was going to teach students from space. We *knew* that it would get our students' attention because — whether age 9 or 90 — humans are still intensely curious about space.

Christa might have been the one scheduled to ride in the *Challenger* but each o'us felt as if we were going with her...and we were determined to take our students on

the adventure, too. We made special lesson plans, bulletin boards and hand-outs and followed Christa's preparations meticulously. We lugged television sets and antennas from home so our classes could participate in the lessons from space. And on January 28, 1986, we, and our students, watched as the Space Shuttle Orbiter *Challenger* was launched.

We didn't teach the lessons we had planned that day. Instead, we taught about courage...the kind of courage it takes to do the daring deed...the kind of courage that Magellan and McAuliffe shared — the courage to risk and explore. And when the media coverage from the accident began to die down, we began to reflect and ask questions. It had been fun and exciting to make all the special plans and the excitement was shared by our students. It was the concept of space — we realized — that had students so excited about learning. And would happen to Christa's dream...her mission?

We, her professional colleagues in Tennessee, decided to keep her dream and mission alive. Not only that, we — and our students — were going to have fun and learn a lot in the process.

Tennessee Space Week was conceived in 1986 by a staff member of the Tennessee Education Association shortly after the *Challenger* accident with several goals in mind:

1. To memorialize *Challenger* crew member and professional educator Christa McAuliffe and continue her mission to stimulate students' interest in learning through Aerospace Education;
2. To utilize space, the last great frontier, as an inspirational teaching tool in all Tennessee public school academic disciplines;
3. To place a special emphasis on Aerospace Education as it relates to mathematics and sciences.

The motto of Tennessee Space Week is: *An Adventure In Education*, and that's exactly what it has been — an adventure.

The adventure began in June 1986 when we wrote a letter to then-NASA Administrator James C. Fletcher outlining what we suspected would be viewed as a fairly outrageous proposal to jointly sponsor a statewide instructional project to culminate the week of January 28, 1987 — the first anniversary of the *Challenger* accident. At a time when criticism and accusations were being leveled at the nation's space agency from every corner, surely — we thought — the last thing NASA administrators want to hear is an untried idea about an instructional program dreamed up by a bunch of space-happy teachers in Tennessee. We were wrong.

Currently entering its seventh year, Tennessee Space Week — now jointly sponsored by TEA, NASA and U.S. Space Camp — has become one of the largest, most successful and innovative Aerospace Education programs in existence. Where we once received inquiries and requests for our materials from other states, we now receive requests from around the world.

From the first meeting when TEA and NASA representatives sat around a table and dreamed of the possible and the impossible, NASA has been a valued partner in the Tennessee Space Week (TSW) effort. TSW has evolved into a dynamic and exciting annual project anticipated by students and teachers alike. This year TSW was officially celebrated the week of February 24-28, but adjunct activities will not be completed until July 24 — the last day of the Tennessee Space Week Teachers' Camp at NASA's Marshall Space Flight Center in Huntsville, AL.

Today, TSW consists of:

1. A 200+ page TSW Lesson Plan Booklet with aerospace lesson plans in everything from rocketry science to home economics and physical education;

2. Teacher training workshops conducted by NASA Aerospace Education Specialists;

3. Student assembly programs complete with space suits and moon rocks, conducted by NASA Aerospace Education Specialists;

4. A TSW Speakers Bureau of NASA experts and other aerospace industry experts who visit schools to lecture;

5. Academic contests such as the Space Shuttle Throw, SPAAAAACE Trivia, I Want To Be A Space Cadet, *Star Trek* Adventure, and Beam Me Up contests — replete with prizes of scholarships to attend U.S. Space Camp, field trips to the U.S. Space & Rocket Center, cast jackets from Paramount Pictures TV series *Star Trek: The Next Generation*, or official TSW t-shirts and ball caps;

6. A special TSW issue of *Tennessee Teacher* magazine, TEA's official journal, each year — filled with lesson plans, class activities, and background articles for teachers on space exploration;

7. Local TV sponsorship of TSW which includes devoting a portion of the nightly local newscast to current aerospace topics;

8. Tennessee Space Week Teachers' Camp which emphasizes Aerospace Education curriculum and helps prepare teachers to take on the responsibility of coordinating TSW in their local school systems.

All of this is administrated and financed by the teachers themselves through the auspices of their professional association — the Tennessee Education Association. Other than a one-time $1,500 contribution from the University of Tennessee College of Education, which was used to purchase paper, no funds for either materials or personnel has ever been contributed towards this effort by either the state or federal department of education. Additionally, NASA and U.S. Space Camp, partners in this project, provide no funds. In-

stead they contribute materials, manpower and expertise to the project.

And now, Mr. Chairman, that I have gotten your feet wet, I can answer the specific questions you posed in your letter requesting my appearance at this hearing:

Why is the space program important to educators? It is important because it expands our knowledge of the universe and addresses the eternal human quest to know and understand. Knowledge and understanding is what education, and educators, are all about. Also, it provides educators with an incredibly valuable tool — a key to our students' curiosity and imagination. Also, it offers solid evidence why we, as a nation, should never lose sight of the value of quality education — just look what educated people, such as those in the U.S. space program, have accomplished.

How do humans in space and scientific space projects stimulate students' interests? — Because students are human beings and human beings are curious. We want to know that which we do not know and try that which has never been done. As if this natural curiosity weren't enough, we Americans come from pioneering stock...we are born explorers. Space and the U.S. space program provide the perfect instructional opportunity for teachers to turn these attributes to advantage in the classroom.

How do NASA's educational programs assist the educational community? — The teacher workshops, assembly programs, and teachers' camp I mentioned earlier are all part of NASA's existing education program — NASA easily adapted them to fit the particular needs of Tennessee Space Week. With the current level of deplorably limited funding for staff development, the teacher workshops and teachers' camp are of particular benefit. Teachers that attend these functions come away recharged with ideas and enthusiasm — as well as their arms laden with materials they can reproduce for classroom use.

Also of great benefit was NASA's guidance. From day one the NASA education staff was available to us and provided the practical guidance and assistance necessary to launch this project. Furthermore, they didn't desert us — they have remained available at every step along the way to nurture, train, and provide expertise whenever needed. We might still have done a TSW project if NASA had turned down our request for assistance in 1986, but it would never have become what it is today without NASA's enthusiastic participation.

And since we've been discussing the curious nature of the human animal, I have a question for you, Mr. Chairman, on behalf of the students and teachers of Tennessee. When can we look forward to seeing the rebirth of the Teacher-In-Space Program and the scheduling of Barbara Morgan, Teacher-In-Space Designee, on a shuttle mission? Not only is Ms. Morgan, a former Honorary Chairman of Tennessee Space Week, imminently qualified for the task — she and we have been waiting a long time.

Thank-you, Mr. Chairman, for allowing me this opportunity to address the committee from an educator's perspective. I'll be happy to answer any additional questions you may have.

Mr. HALL. Thank you.

Mr. Walker, who is the ranking Republican on the big committee, Science, Space and Technology, he's the head guy on the big committee. I guess he's about the number three Republican in the House, is that right? Or are you number two?

Mr. WALKER. I'm Chief Deputy Whip.

Mr. HALL. Chief Deputy Whip, whatever that is.

Mr. WALKER. Where that puts me in the hierarchy, no one is quite sure.

[Laughter.]

Mr. HALL. Whatever happens up here that's good, he's usually in the front leading it. Your faith is well justified.

I recognize the gentlemen from Pennsylvania, if he wants to say a word about Mrs. McIntyre.

Mr. WALKER. Thank you, Mr. Chairman.

I do have an opening statement here that I would like to have put in the record at the appropriate point. I also want to welcome Nancy McIntyre from West Chester here, as she is the driving force behind the Educational Center for Earth Observation Systems and the Coordinator of the annual National Satellite Education Conference at West Chester University that I have had the opportunity to attend. It is an outstanding program aimed at students.

I am very happy that she has taken time from her schedule to appear before us today as she represents a program which is one of the best programs I think that education has to offer in conjunction with the space program. It is exactly the kind of thing I think we are trying to propose.

[The prepared statement of Mr. Walker follows:]

STATEMENT OF THE HONORABLE ROBERT S. WALKER
HEARING ON THE U.S. SPACE PROGRAM BENEFITS TO EDUCATION
JUNE 10, 1992

Mr. Chairman, I thank you for holding this hearing today on the positive impact that the U.S. space program has had on students. So often these days we hear that American students are uninterested in science and math and that they are faring poorly in these subject areas compared with students in other countries. As a former teacher, I am concerned about these reports and have been an advocate of reforming the way we educate children. Today, we have the opportunity to hear from the NASA Administrator firsthand about the agency's programs, and from educators who are involved day-to-day in what goes on in American classrooms.

I would like to extend a special welcome to Mr. Goldin in his first appearance before a congressional committee as NASA Administrator. Also here today is Nancy McIntyre of West Chester, Pennsylvania. Mrs. McIntyre is the driving force behind the Educational Center for Earth Observation Systems and coordinator of the annual National Satellites and Education Conference at West Chester University.

I look forward to the testimony of all the witnesses. Thank you, Mr. Chairman.

Mr. HALL. The Chair recognizes Mrs. McIntyre. You can't go anyway but downhill from there.

[Laughter.]

STATEMENT OF NANCY R. MC INTYRE, DIRECTOR, EDUCATIONAL CENTER FOR EARTH OBSERVATION SYSTEMS, WEST CHESTER UNIVERSITY, WEST CHESTER, PENNSYLVANIA

Mrs. MCINTYRE. Thank you, Mr. Chairman, Congressman Walker, and other distinguished members of the committee. We think Mr. Walker is number one.

One other thing of which I am proud is West Chester joined the Pennsylvania Space Grant Consortium, and I am the Associate Director for that, which is an outstanding program. But satellite technology is an exciting and effective tool to generate student interest in math and science. Satellites and space technologies encourages them to want to learn more about the processes of science, and the results have been a better informed and educated society.

The value of the space program in terms of discoveries, knowledge gained, and technological advances for our Nation has been apparent. However, our educational institutions initially did not take advantage of these advances, nor make students aware of the opportunities they afford.

Every year, there is a new national study that indicates our students are falling behind others in math and science. Every year the recommendations follow the same pattern: stimulate interest, provide hands-on opportunities and problem solving experiences, and make instruction relevant to the real world. The space program provides opportunities for educators and students to do just that.

During the 1970s, educators thought of exploration beyond earth and wanted to energize students and prepare them for the world of tomorrow. During the early 1980s it became apparent that the cost of the social and economic issues would be weighed against the space program. During those decades, if students were learning about space, they would be learning more in terms of the various NASA programs at that moment, the different types of satellites and how many men had walked on the moon.

The primary reasons for this were that textbooks did not include anything about the space program, most textbooks are 28 years behind reality. Equipment affordable to education was nonexistent, and most importantly, space and satellite technologies were not considered important parts of teacher preparation programs.

The space program was of interest to the Nation as a whole. Everyone stopped and stayed up to watch people walk on the moon. But it did not really affect student interest or achievement in school, except to make students want to enter NASA, NSTA or any other national contests or, as many others have said, to make them dream of becoming astronauts. That possibility only affected a select few.

But later that decade, something exciting happened when the focus of the space program turned back to earth. Environmental satellites were no longer our Nation's best-kept secret. They were beginning to be recognized as tools for improving education. This, however, was more than 20 years after the first TIROS was built

under contract by NASA, built by GE or RCA, now GE Astrospace, and launched in 1960. Also, communications satellites were now providing rural schools distance learning programs an opportunity that normally was not affordable to them.

Innovative educators, on a shoestring budget, realized that while everyone could not be an astronaut or a rocket scientist or a satellite engineer, students could be part of the space age and could do scientific work without realizing that they in fact might be learning science.

These educators built their own satellite receiving equipment with amazing results and are receiving live satellite images. They suddenly became excited about science. There were no other cost, the Government had already funded the contract through NASA. The resulting data was free to any educator with the receiving equipment.

The educational pioneers in this field willingly shared their newfound knowledge with others and began to influence education. Five years ago, these educators were few. You could probably name them on your hand. Today there are hundreds across the Nation utilizing this technology. As Wendell indicated, he had attended a teacher training workshop to see first-hand what direct readouts did for students.

However, as again I had mentioned, education cannot do it alone. We recognize the importance of teacher preparation and the valuable contribution of the expertise of those who in Government agencies such as NASA and NOAA. Even in difficult economic times, at West Chester we have found that industry is interested in education, wants to enhance math and science education through space technology, and they have funded various programs including the conference that Congressman Walker mentioned.

These companies are such as Bell Atlantic, DuPont, GE Astro Space, GTI Electronics, Hughes, and IPS of California. Also, we could not have had the conferences without the financial support from others and NASA and NOAA.

Today, this equipment has become affordable for all schools. Ten years ago, the cost of equipment was over $100,000, because only industry wanted to track satellites, for whatever economic reason, whether it be the fishing industry, the home building industry, legal profession. But today, any school in the country can obtain a receiving station if they have a dedicated computer for under $1,000.

Teachers have found that satellites can excite all students, not just the gifted and talented. All students can learn and succeed, and in these classes they have found success breeds success. For example, there is nothing more rewarding to a student than to be able to go home that evening with a satellite image that he or she has personally tracked, received and color-enhanced in his classroom.

For example, Unionville High School, in southeast Pennsylvania, has earth and space science classes which are not for the gifted. Enrollment jumped from 56 to over 200 students in less than five years. The students were non- college prep. They decided to throw the textbook out the window and dedicate their curriculum to satellite technology. They built a receiver. When they heard that first

beep, beep of a Russian satellite, you would have thought they had walked on the moon.

Now, how do I know this works? Personally, I have seen first-hand what it has done for my daughter. She was in one of those earth and space science classes. But in her high school, the guidance counselor steered her into science classes, as do most high school guidance counselors, and encouraged them to get into the right courses to get the right knowledge to score the right scores on SATs and get into the right college.

She captured an image of Hurricane Hugo and generated enough excitement that she was interviewed by a newspaper reporter. She therefore gave presentations, she assisted in the first NASA funded teacher training technology workshop. And she taught the teachers how to track the satellite.

Now if that is not success, I have never seen success in a student. She helped the students build a model of the TIROS satellite. They came down here and presented it to the Secretary of Commerce, and it now hangs in the National Weather Museum. She experienced success in science.

Secondly, West Chester University hosts an annual Satellite and Education Conference so that other teachers can learn more about this technology. It developed because a teacher at Unionville thought that if there were a handful of teachers across the country, they would not talk to anybody because other teachers did not really know what they were doing. So they got together in a group. Until this spring, there were almost 200[1] educators from 30 states, Canada and France in attendance.

Secondly, as I said, West Chester also has some firsts. We held the first NASA funded technology workshop, for which we have always been very grateful. We were one of the first to be a Challenger Center linkup site for Marsville. And the middle school student excitement just about raised the rafters of the gymnasium. A middle school student wandered in.

His mother worked for the university, and it was spring break, and he was on campus. He wanted to know what we were doing, and I explained what we were doing. He was in a neighboring middle school of one of the middle schools that was in attendance. I said "Gee, I'm sorry your school didn't attend." He said "My science teacher would never do anything that was fun." He saw this as having fun, they were learning, they were having a great time, but that was not what was happening in his class.

But as I said, educators do not have the time or resources to do it alone. They need lots of help from NOAA, NASA and both agencies are needed for information and support. NASA has a great educational division and regional teacher resource centers. As I said, the Space Grant Consortium institutions can play a leadership role.

For example, Pennsylvania's consortium is going to put a receiving station in a rural school in Pennsylvania.

I might digress for one moment and tell you a story about Mr. Owens, since he is sitting here in the audience. Four years ago, I

[1]Additional information provided by Mrs. McIntyre corrects number to 280 educators.

came down to Washington to meet with some people at NOAA, because they are one of our conference supporters. He was going over to a meeting at NASA about the international space year. He invited me to come along. Around this table were probably 20 people, leaders in NASA, NSTA, other agencies that they wanted to buy into the ISY program.

I was sitting there, not really knowing anything about it, but just quietly sitting, taking it all in. And at the end of it, I found out that one thing Washington has exclusively is acronyms. So after sitting there listening to the presentations for several hours, at the end of it, he recognized me and thanked me for representing education. He said "Now do you have any questions?" I doubt if he remembers what I responded, but I said "Yes. Just tell me what is a SAFISY?"

And it broke them up. It stood for—just in case any of you were not in on that meeting—Space Agency Forum for the International Space Year. But they said "SAFISY will do this, and SAFISY will do that." And I thought, "Gee, I never heard of a SAFISY."

But he is a great guy, and I had to throw that in since he was here. And Dr. Brown spoke this spring at the conference, and we really do appreciate everything NASA does for us. Thank you.

However, now the satellites are launched, and then NASA gives their domain over to NOAA for management. NOAA provides the predict data for the educators. It was only two years ago that NOAA recognized they needed an educational affairs division, because as more and more teachers were getting into this program, they found out that they needed a full-time staff to field the questions. But its impact is severely limited, like every other agency, because of budgetary cuts.

However, as I am sure all of you know, the importance of the global satellites and the cost effectiveness to under- developed nations cannot be overlooked. No major weather storm has gone undetected since the advent of these polar orbiting satellites. And when NASA and NOAA share their expertise and interests, such as the International Space Year, which was a fantastic idea, and the Mission to Planet Earth, everyone benefits.

America 2000 has established lofty educational expectations. One of the goals of our center at West Chester is 2000 by 2000, meaning we would like to have 2,000 receiving stations in 2,000 schools across the country. That would only cover approximately one-fifth of all the school districts in the country. But it is realistic, and it's a start. This compares to the hundreds already in Great Britain and Wales. Plans are underway this year to put a receiving station in every secondary school in Wales. Even though we invented the technology, the other countries are running away with what they are doing for education.

In closing, I would like to leave you with a few quotes. The President of the University, when he opened the conference, said "Our children naturally turn to the skies. Our job is to use today's technologies to help them maintain that fascination and guide them on intellectual journeys far beyond those we can now take."

When he closed, the Dean of the School of Education said "I want to challenge each of you as educators to use the International Space Year as a way to rejuvenate yourselves and energize your

students about the possibility of using space exploration in education." And if they didn't know how to do that, he invited them to come to West Chester and learn. To our knowledge, West Chester has the only school of education which is promoting satellite and space technology.

So suffice it to say that yes, there is hope for math and science in our Nation, and space and satellites will definitely play a major role.

Thank you very much for inviting me, and we would love to answer questions.

[The prepared statement of Mrs. McIntyre follows:]

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STIMULATING INTEREST AND ACHIEVEMENT IN MATH AND SCIENCE THROUGH THE SPACE PROGRAM

BY

NANCY R. MCINTYRE, DIRECTOR
EDUCATIONAL CENTER FOR EARTH OBSERVATION SYSTEMS
WEST CHESTER UNIVERSITY
MEMBER, PENN STATE SPACE GRANT CONSORTIUM

TESTIMONY BEFORE THE
U. S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

JUNE 10, 1992

Satellite technology IS an exciting and effective tool to generate student interest in math and science. Satellite and space technologies encourage them to want to learn more about the processes of science. The results are a better educated and informed society.

The value of the space program in terms of discoveries, knowledge gained, and technological advances for our nation is apparent. However, our educational institutions initially did not take advantage of these advances nor make students aware of the opportunities they afford. Every year there is a new national study that indicates our nation's students are behind others in math and science. Every year the recommendations follow the same pattern--stimulate interest, provide hands-on opportunities and problem-solving experiences, and make instruction relevant to the real world. The space program provides opportunities for educators and students to do just that.

During the 1970's educators thought of exploration beyond Earth and wanted to energize students and prepare them for the world of tomorrow. During the early 1980's it became apparent that the cost of the space program had to be weighed against the social and economic needs of the nation. If students were learning about space in a typical classroom, it was more in terms of the history of the NASA programs, the different types of satellites, and how many men had walked on the moon. The primary reasons for this were: textbooks did not include anything about the space program; equipment affordable to education was nonexistent; and, most importantly, space and satellite technologies were not considered important parts of

teacher preparation programs. The space program was of interest to a nation as a whole but did not really affect student interest or achievement, except to enter NASA, NSTA or other national contests or to make them dream of becoming astronauts, which was only possible for a select few.

Later in that decade, something exciting happened when the focus of the space program turned back to Earth. Environmental satellites were no longer our country's best kept secret and were beginning to be recognized as tools for improving education. This was more than 20 years after the first environmental satellite was built by RCA (now GE Astro Space) and launched in 1960. Also, communication satellites were providing rural schools distance learning programs and opportunities that normally were not affordable.

Innovative educators realized that while everyone would not be an astronaut, rocket scientist, or satellite design engineer, students could be part of the space age and do scientific work without realizing they were learning science. These educators built their own satellite-receiving equipment with amazing results and were receiving live satellite images. There were no other costs; our government funds the contracts through NASA and the resulting data from the polar-orbiting satellites is free.

The educational pioneers in this field willingly shared new-found knowledge with others and began to influence education. Five years ago, these educators were few; today there are hundreds across the nation utilizing this technology. They cannot do it alone. We recognize the importance of teacher preparation and the valuable contribution of the expertise of those in governmental agencies, such as NOAA and NASA. Even in difficult economic times, we have found industry interested in enhancing math and science education through space technology and have obtained financial support from Bell Atlantic, DuPont, GE Astro Space, GTI Electronics, Hughes and IPS of California.

Today, this equipment is affordable to all schools and teachers can stimulate student interest in tracking satellites and doing research. Teachers have found that with satellites **all** students can learn and succeed and that in their classes success breeds success. For example, there is nothing more rewarding to a student than to be able to go home with a satellite image that he/she personally received after tracking, especially if he/she is following a storm that has not yet been discussed on the evening weather. Unionville High School (southeast Pennsylvania) saw enrollment in Earth and Space Science classes jump from 56 to over 200 students in a few years after the students built a station, tracked satellites, and color-enhanced images.

HOW DO I KNOW THIS WORKS? I have seen first-hand what the program has done for my daughter. She took science courses because that is what one does to get good SAT scores and acceptance into college. However, in her science class that tracked satellites, she captured an image of Hurricane Hugo, was interviewed by a newspaper reporter, gave presentations, assisted teachers at a satellite technology workshop and helped build a model of a TIROS satellite that was presented to the Secretary of Commerce and now hangs in the National Weather Service Museum. She experienced success in science.

Secondly, West Chester University hosts a Satellite and Education Conference to enable educators (K-12 and post-secondary) to learn more about this technology and share their innovative programs with others. (To our knowledge, West Chester's School of Education is the only one in the country incorporating this technology in its teacher preparation program.) Conference attendance jumped from 45 initially to almost 300 educators from 30 states and two foreign countries five years later.

Educators do not have time to do it alone and need governmental help to make their job easier. The importance of NOAA and NASA is realized and both agencies are needed for information and support. NASA has an educational division and regional teacher resource centers. The NASA Space Grant Consortium institutions can play a leadership role.

However, after launch, NOAA manages the satellites and provides the product data. It was only two years ago that a very-much needed NOAA Educational Affairs Division was created. The impact is severely limited because of funding, even though NOAA environmental satellites are extremely important and cost-effective in global potential compared to other technologies today. For example, no major weather pattern has gone undetected since the advent of satellites with immeasurable savings of lives and property. When NASA and NOAA share common interests, projects, and expertise, such as the International Space Year and Mission to Planet Earth, everyone benefits.

America 2000 has established lofty educational expectations. One of the goals of our Educational Center for Earth Observation Systems is the installation of 2,000 receiving stations in schools around our country by the year 2000. This would cover less than 1/5 of the school districts in our country but is realistic and a start. This compares to the hundreds already in Great Britain. Plans are in place for every secondary school in Wales to have a satellite receiving station this year. In this regard, Great Britain currently has the lead on us even though our nation invented the technology.

In closing, I will leave you with a few quotes. The President of West Chester University recently opened our satellite conference by saying, "Our children naturally turn to the skies; our job is to use today's technologies to help them maintain that fascination and guide them on intellectual journeys far beyond those we can now take." The Dean of the School of Education closed it with these remarks, "I want to challenge each of you as educators to use the International Space Year as a way to rejuvenate yourself and energize your students about the possibilities of using space exploration in education...if you don't know how to do this, come to West Chester University and find out!"

Suffice it to say that, "Yes, there is hope for science and math education in our nation and space and satellites will play a major role."

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EDUCATION

1965 B.S. in Education, Bloomsburg University, (Cum Laude)
1968 M.S. in Education, Bloomsburg University
1980 Computer Courses, West Chester University

PROFESSIONAL EMPLOYMENT

West Chester University, West Chester, PA - Director, Educational Center for Earth Observation Systems, School of Education, 1988 - Present. Director, West Chester University/Pennsylvania Space Grant Consortium, 1992.

Unionville High School, Unionville, PA - Teacher; 1966 - 1973, Assistant, Media and Computer Specialist, Substitute Teacher, 1980 - 1988.

Chester County Adult Night School, West Chester, PA - Instructor, 1980 - 1987.

OTHER ACTIVITIES

Consultant to Washington, DC., School District in writing of a Technology Grant Proposal, Summer 1988.

Author, Eisenhower Math/Science Title II grant for Teacher-Training Workshops in Satellite Technology, 1989.

Coordinator, National Satellites and Education Conference, West Chester University, West Chester, PA, March 1989 through 1992, obtaining sponsorship from NOAA, NASA, GE Astro Space, IPS of California.

Coordinator, NASA funded, Environmental Research Institute of Michigan's Satellite Technology Education Program Workshops, Summer 1989.

Coordinator, PA Title II-funded Satellite Technology Workshops, West Chester University, Summer 1990.

Mr. HALL. I think just your testimony alone cries out to the importance of this number two panel. While you may not have the national and international visibility that the first panel had, you are every bit as important, and maybe more so because you have such a direct effect on young minds.

It must really be comforting to you to see them come into and under your guidance and then see them leave with some maturity and some confidence that they are going to be okay. That's certainly a talent and a profession that's second only to the ministry, as far as I'm concerned, and gives back to the receipts that you all acknowledge here in your resume.

I think it's great that there is still room for Magellans and Columbuses in the field of education. You all fit that role very well. Congressman Walker told us of Mrs. McIntyre and Ms. Payton, the head of all the teachers in the great State of Tennessee, and the NEA representative, and Mr. Mohling established the first direct readout station, was a finalist in the NASA Teacher in Space program, and is a guy that has just absolutely devoted his life to teaching.

Now where in Nebraska—you mentioned a little town, I though you would say what it was?

Mr. MOHLING. My home town was Fairbury, Nebraska, and I went to Bower School District 16 for eight years. There was no kindergarten offered in the rural schools at that time. It was two weeks in the spring that you got to visit the teacher at the school, and that was all.

INFLUENCE OF SPACE PROGRAM ON STUDENTS' MATH & SCIENCE INTEREST

Mr. HALL. Each of you have experience in teaching students, and you use the space environment to stimulate interest in math and science, and I think that's great.

We attended the University of Oklahoma, this subcommittee did, seven or eight years ago. We had testimony from the President of the University there to the effect that they had a local high school there that had to interview 72 people before they could get someone both qualified and interested in teaching general science alone.

I think that cries out the need that we have. Then not only to attract them to teach the sciences and the math, but to get them to use the space environment through which and with which to teach it and stimulate interest.

How has the space program affected the interest of your students in math and science? How do you tie them together, Mr. Mohling?

Mr. MOHLING. A lot of the programs we offer today are reaching out to a larger audience. I think at one time, oftentimes those of us in the school systems are guilty of this, we offered science and mathematics maybe only to the elite. We offered science and math only to those who said "I am interested in that," so we did more to support those interested students.

KEEPING STUDENTS INTERESTED

Mr. HALL. I know how you keep them motivated, you work at it. You have a real interest in it. How does the run of the mill teacher keep youngsters motivated in science and math?

Mr. MOHLING. I think the first thing we need to do is help those teachers to have the proper tools and the teaching techniques and strategies using hands-on science. That's what we have been seeing happen throughout our organization, NSTA over the last couple of years, as teachers go to meetings and workshops and begin doing hands-on kinds of activities and experiencing science the way it ought to be taught through a process. By doing it, they are also taking it back to their school.

Other teachers are gaining from that excitement. They see what's going on next door, and they peek in and gain interest, too. That's why many of our teachers are now saying "We need to do much more of making science available to all." In fact, oftentimes I am heard to say that science perhaps should be the basic to help integrate all the other subjects. Of course, I have a selfish interest in science.

But that really is a perspective. My daughter has recently finished sixth grade. In her elementary classes, a fourth-grade teacher in particular that basically use science as a strand, as a thread, as an interest vehicle, tied together the language arts, the mathematics and the other subject areas to some of the things they were doing in science. So they not only came away with a very good science program, but she also enhanced her skills in the other areas, too.

Mr. WALKER. If the gentleman will yield. I think you are making a very valuable point, and it's one we ought not skip over. I think it's even more fundamental than what you suggest. With the technological revolution and the scientific revolutions literally sweeping the world, much of the news that's on our front page involves scientific interpretation of one kind or another.

When the other day we had the news come out about genetic manipulation of food, that's the kind of thing that some fairly demagogic people can use for a massive scare technique in the country, particularly people who have absolutely no idea what the science is behind what's going on there. To have a population that has a fundamental understanding of science is important to us surviving as a democratic nation. Because if what you can do is use all this technological revolution and scientific revolution as a way of manipulating people away from progress and advance, we are in trouble as a country.

And if we don't get science to people other than those who are going on to college and we don't have a broad-based understanding, I think we are in terrible trouble. I have just looked over a period of some years now, at how many stories on the front pages of newspapers, or how many stories at night on the television news involves some degree of scientific interpretation in order to understand the full import of the story. It's phenomenal how much of our news is based upon that. So you make a very, very fundamental point, I think.

Mr. MOHLING. If I may respond, I think sometimes we unfortunately make a joke about our ignorance of technology as a citizenry. We joke about the fact that the little VCR blinks 12, 12, 12, and we don't know how to program it, and so forth. But in one way, there is a real serious side to that, and that is that we oftentimes don't really take seriously the understanding that is needed to be a good citizen of this country in this era of science and technology.

I think it underscores the importance of those of us in education to work very hard, not only with the students in schools, but the public, for the adult community as well, to bring them up to speed in terms of understanding some very fundamental, scientific principles to prevent the kinds of chaotic problems that you are suggesting.

Mr. HALL. Ms. Payton?

Ms. PAYTON. I would like to add to what Wendell said a few minutes ago on one point. Understand, I am a social studies person, okay, I'm very protective of my program.

Mr. WALKER. So am I, by the way, I taught social studies.

Ms. PAYTON. Good. But I also see—

Mr. HALL. I flunked them.

[Laughter.]

Ms. PAYTON. Mr. Chairman, I thought you knew everything.

But I also see, and I am a strong believer that we have a tendency to steer away, even in the teaching profession, and it's not so much set in place by the classroom teachers, but by those who make the decisions as to how we will conduct our classes, to steer away from the interdisciplinary approach to learning. Because that's what we ought to be about.

I could take the scenario you just gave and tie it into a reading class. Let's talk about fact and opinion. Is that a fact or is it an opinion? I will not say to the children, "It is a fact," or "It is an opinion." Let's go and do our own research. Because the curiosity is there. And you find something like that and you built on it, you go out and you develop within the kids a reasoning, researching judgment. You go out and find out for yourself. And you will not settle for that. You don't have to necessarily be majoring in science. Don't get me wrong, I'm very supportive of science and math, especially since I'm here with this committee.

But I see learning, and I see the skills that are a part of the science and math and reading, all of these skills coming together, so that we do indeed have a citizenry that thinks well, and uses creative abilities, and judges things, and does all of those things that are necessary.

The other point I want to make about the Chairman's question, and Wendell's response, and again, I am a strong believer in this, staff development is germane to our profession. However, it does not get on the list of priority in most of the school systems. I will say most as it relates to Tennessee, because I don't want to step on anybody's toes.

But we have a tendency to believe that staff development is not important. In the profession we are in, where things change every day, every week, things are happening, and because we deal with these little curious minds that come into our classrooms, we have got to try to be on top of everything, stay up with the issues.

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So staff development, I believe, is an important part. We don't get enough of it. We don't get enough of NASA. I have tried for about six years to get our state department to finance, fully finance, staff development so that we don't wait for Tennessee Space Week to bring a NASA group in to help us, but that we have it as an ongoing part of our goal- setting, and we have it all year, and bring them in at a specific time.

Also I would say to some people in the State of Tennessee who choose to look at reforming education or improving education in our schools for profit type thing, that we ought to take monies like that, sit down with educators, maybe we could have our own Challenger Center in the four major cities in the State of Tennessee, so that we can offer all children an opportunity to learn all of these. And we could have many, many more Damons, especially Damons without two parents, and have that interest there, and make sure we touch all of those publics that we are working with.

Mr. HALL. Mrs. McIntyre, if it will renew your faith in me, I made the highest of all that failed.

[Laughter.]

Mr. HALL. Mrs. McIntyre, you are recognized.

Mrs. MCINTYRE. As I have said before, I think teacher preparation is the key. If you think back to the teachers who you said were dynamic, you learned a lot from this person, if you think about why, that person probably had a lot of self- confidence in his or her own knowledge base. They were not afraid to try something new, and if they failed, then you moved on. Just as I have seen teachers with this direct readout, they did not set up their station on day one, track a satellite, color-enhance it. They tried and failed.

This is a program that can start in the elementary schools and catch the excitement. Because every student has played Nintendo now, and they can put together the equipment. The dean took our receiving station, when we got it, took the equipment over to an elementary school. The kids knocked him out of the way and took it and put it together. He thought it would probably be broken.

In an hour they had it together and were tracking a satellite and thought nothing of it. Nothing of it. He was more apprehensive. If you get the teachers in, they are very gingerly touching it, as you would if you had a new Rolls.

But the students are not afraid of it. The elementary schools can start, if they only use it for geography. If the students track an image, the first thing they want to do, and I think you have a copy of an image in your packet, the first thing they want to do is find out what they are looking at. Then they look at recognizable things and they pick out the Great Lakes, they can pick out Florida, the Atlantic Ocean, what is this big blob? Well, that was Hurricane Hugo. In the next image, maybe Hurricane Hugo is a little further up the coast.

Then they start getting interested, wondering "Is this going to hit us?" It generates a lot of discussion. The social studies teacher at Unionville came to the earth science teacher because it was monsoon season, and they wanted to discuss that, how it impacted India's economy and weather, so they wanted images of India. During Desert Storm, everybody knew what the Persian Gulf

looked like, and the art students loved color-enhancing satellite images. This was done at a high school, by high school students.

If you learned nothing else but the geography of it, in elementary, the color schemes, if the ocean is pink to start with, and it can be, before they color-enhance it and take it home, the water is going to be blue and the land is going to be green or brown. Then they can learn all kinds of different things, as far as the teacher wants to take them.

But teacher preparation is the key. If the teachers buy into it, you know the students are going to. If the teacher is enthusiastic, the students will buy into it. Mr. Rohrabacher, you can take pride in knowing that behind Pennsylvania, California has the most direct readout stations.

Mr. HALL. I guess the thing I really wonder, before I recognize Mr. Rohrabacher, is how many—obviously you all are a cut above the teachers, and you must know that, there is no reason to deny it. As the dean says, it ain't bragging if you can do it. How many other teachers though, and what's the difference from teachers like the three of you and the rank and file all across this country in the states that rank behind Pennsylvania and California?

Mrs. MCINTYRE. I think a lot of the other states are catching up fast. For example, Florida statewide is going to put 30 receiving stations into their schools. Maine has already gotten on the bandwagon and probably by now has a dozen from elementary on up. In Maryland, the Johns Hopkins Space Consortium is going to put 12 stations in and around Baltimore. So again, somebody has to train and prepare the teachers. Someone has to get excited about an idea.

I will go to a conference and not know anything about it, as I did the Challenger Center's National Conference. They said "Do you want to be a Marsville site?" Well, certainly, I had no clue what that was, but of course we would do it. If you are not afraid to take chances, if these bubbles didn't go up, and the fan didn't keep them in place, and I didn't think they would, but they all worked. The middle schools had that, that tape is tight as can be, and everything just flowed.

But all the teachers have to jump in with both feet. They can't swim, because the lifeguard is on the bank. That's what they have to realize.

Ms. PAYTON. May I just throw in one thing? There are a number of teachers who are out there who are enthusiastic and want to get involved. We run into another problem here. Look at your leadership as well, leadership in terms of your principals and your supervisors.

If that enthusiasm is not coming from the head, even the superintendent, people are not turned on to doing what's best for all children, and though I support—not wholeheartedly—having systems with just magnet schools everywhere, I think we can do a lot for a lot of schools so that we cannot deny anybody access to the best.

But if we could get our top people, our leaders within the education family to buy in, to understand, and not be afraid to take a risk, to say "This is what I want for the children of my school system."

I must tell you, in Tennessee, with the Tennessee Space Week, our biggest supporters are our parents. They get so involved during Tennessee Space Week, they cannot wait for it to come, and they do their part in setting up radio stations and television stations and hitting the newspapers. Because they want their kids involved, and not one parent wants their child left out when the astronaut comes to the school. Everybody is present that day.

If the space lab is coming to the community, everybody shows up. Nobody is absent. Even the superintendents and everybody will come out, parents. So when you have got that kind of enthusiasm from the administration, and I am proud to say that all of our superintendents in Tennessee buy into the concept of Tennessee Space Week, they really had no choice. The excitement was there.

So now it's just a joint effort. Everybody is pitching in. That's what it takes to really put together a quality education program that brings in the math and science and ties all those fields in so we can all do all these fine things.

Mr. MOHLING. Could I respond to your question also?

You offered a very challenging question. First of all, I would have to say that even though you spoke very eloquently about all our successes, there really are countless thousands of teachers out there who really do the same things we do every day, and they work really hard in much more deplorable conditions than what I have taught in, and are quite successful.

I think that we as a Nation are now discussing education much more. We are focusing on national goals and national commitments and national standards. I think some of that is going to be very helpful for people and students that I have in my classes to focus on education.

Right after the Teacher in Space program, shortly after the Challenger accident—we take a poll each year at my high school on careers—and for the first time in many years going into teaching or an education career was number one on the senior's list. That was unheard of. The counselors thought they had made a mistake in the data collection.

There are lots of students out there, but they are also watching what we are doing as a Nation for education. We have to do a lot more support for schools and for teachers, get those teachers off the ladders in the summertime who are painting houses, so they can be in the classrooms to do more effective jobs, to acquire the kinds of skills and techniques we are talking about here.

They are very eager to learn, they want to learn, and I think we can perhaps tweak the system a little bit to give some of those teachers some of the opportunities that perhaps those of us here at the table have had the good fortune of having.

So I think there is a sincerity of purpose out there. We need to work hard, all of us together, to support those other teachers that would like to do the same thing we are doing.

Mr. HALL. It wouldn't hurt to have a little better pay grade for teachers, either, would it?

Mr. MOHLING. Why not?

Mr. HALL. Just like in public service, there was a time when all the really great minds in this country wanted to go into public service. the Thomas Jeffersons, the Hamiltons, Benjamin Frank-

lins, the inventors. Now they go into the computer world. It's the same way in teaching. In many states, and I'm not sure just how my state handled it, but it appeared to me that instead of putting money in and pulling the bad schools out, they simply pulled the good schools down to try to equalize educational opportunity. And that's a poor way to address it.

So really and truly, when you just get right down to it, cash in hand paid is one thing that's badly needed to entice, to obtain and retain men and women in the field of education. They can't all be like you three that are here for the love of seeing that that walks in your door, and having the pride of that that walks out. That's enough for many teachers, but it's not enough for the youngsters today that we are trying to entice into the teaching world.

I have used way more than my time, and recognize the gentleman from California, Mr. Rohrabacher.

Student Career Goals

Mr. ROHRABACHER. Thank you, Mr. Chairman. I will try to be brief.

Mr. Mohling just mentioned a poll that was done among your students. How many of the students were interested in going into engineering or science as a profession?

Mr. MOHLING. At my high school, we have a large interest in medical professions, then probably next to that would be engineering and science professions. We have a very active science department, we have a lot of involvement of students in doing research projects and so forth. So I don't know how we would compare to other schools, but I would have to say that for my high school and my school district that we have a substantial number of scientists and engineers that go into those careers.

But probably the thing that ought to also be known is that I have also seen a number of students who had very, very good science talent who were attracted, perhaps because of the paychecks and so forth, to other careers. And sometimes that's disappointing to a teacher, when you know that that person really could have been the next Nobel prize winning scientist.

Mr. ROHRABACHER. When you say attracted to other careers, as in what?

Mr. MOHLING. Well, in the two instances—

Mr. ROHRABACHER. I hope you're not going to say lawyers.

Mr. MOHLING. Well, that's one of them. It certainly is true, and with the focus of other things that impact their life, students, many of them, are interested in the legal profession. The other one, a couple of years ago everybody in my community, or at least a lot of the students, because they would see what was happening and perhaps from goals of their parents and other adults were also interested into going into financial careers, banking and all those sorts of things. Because the dollar was what they saw in the minds and goals of their parents and neighbors.

Salary Differences

Mr. ROHRABACHER. One of our colleagues, Mr. Armey from Texas, has Armey's Axioms, and one of them is a society that pays

its lawyers more than its engineers is in trouble. So talking about pay, the Chairman touched on pay for educators. I would like to ask, is there a differentiation in your school districts, and this is to all the panels, to try to encourage science and engineering teachers? Do science, engineering and mathematics teachers receive more pay? Is there any differential?

Or is this a situation where a teacher that teaches physical education, for example, gets the same pay as a teacher who teaches science who might be able to go out in the private sector and receive a lot more money for his or her knowledge?

Mr. MOHLING. There is no pay differential. There is no differential in terms of work load. I teach the same number of classes as my colleagues. There is no extra support for things like laboratory preparation. There is no support in the say of assistants, aides, para-professionals, in that regard. In some schools, they do have those types of support systems. But I would say that's in the minority of schools.

Mr. ROHRABACHER. Do teachers who teach science, mathematics or engineering receive any more pay than the teachers who are teaching other subjects?

Mrs. MCINTYRE. I don't know of any in any district in Pennsylvania. The Teacher's Union Association would be jumping up and down, because you would then be weighing one teacher's skills against another. Trust me, they wouldn't even bring that issue up.

Mr. ROHRABACHER. In the private sector, what usually happens when people graduate from school, they find that there are some professions that people go into and they make less money because there is less demand and the skill maybe doesn't require a higher skill level. I, for example, went into journalism. I found out very quickly that there is very little demand for people who want to be a journalist, and you make very little money.

The fact is, sometimes we have a need in our society for more people who understand mathematics and understand engineering and science. First of all, I applaud the programs that you have outlined for us today. Because it will indeed stimulate the interest of young people to go into these fields that are necessary for the United States to be a competitive society.

And I think that—anyway, I guess another panel should be discussing the differential in pay. So thank you very much.

Mr. HALL. All right. Ms. Norton, we are going to recognize you in a moment to make some introductions. We are honored to have you sit in with our committee, and since we are all three lawyers, we didn't totally agree with what Mr. Rohrabacher said about engineers, did we?

[Laughter.]

Mr. HALL. We will certainly extend you the courtesy of addressing this panel, if you care to. Or you might want and direct your remarks to the panel you are going to introduce. The Chair will recognize you at this time.

Ms. NORTON. Thank you, Mr. Chairman. You are very kind. I will wait until my three witnesses, as I like to think of them, come forward.

Mr. HALL. We thank you very much.

I'm sorry, Mr. Walker. The Chair recognizes you. I thought you used up your time when you added in on mine a while ago.

[Laughter.]

Mr. HALL. But since you are the deputy whip and the ranking members, I will recognize you for as long as you want.

Mr. WALKER. Thank you, Mr. Chairman. I won't take very long.

But there are a couple of things that have come up here that I think I would just like to explore a little bit with the panel. I come at this as somebody who was a school teacher for a time and whose wife is now a school administrator, and in fact is the director of curriculum and staff development for a city school district. So I at least know second-hand a good deal of what goes on.

The one thing that I think comes across as I hear you talking is that this really is kind of the vanguard of the future of education. We need far more than what Education 2000 is telling us, and what a lot of the rest of the so- called educational reformers are telling us. Because ultimately where technology is driving us is toward a whole new way of doing education.

In an industrial era, what we tended to do was take all these individual students and bring them in and try to pull them all out at the end looking all the same. Because we wanted them to go to work on production lines where that would be the kind of products they make.

The fact is, the next century isn't going to look at all like that. And we had better be prepared as a Nation to treat every child that comes into the schools as an individual, and design an individual instructional program for them, and utilize their interests and their talents in ways which do give them hands-on experience. That's what you are beginning to do here.

What we have here is an ability to tap into an interest that is very broadly based with students. I find as I go into the schools that space is certainly a major interest. And then we build off that, as Ms. Payton put it, into the interdisciplinary approach. You get some fast-hitting results.

What we are going to have to do is we're going to have to not only retrain teachers in that mold, that they are no longer lecturers, but they are information providers, they are basically mangers of information in the classroom, a totally different role. But in addition, we are going to have to refocus the schools toward the kinds of technologies that you are now working with. You are going to have to put interactive technologies, computers and everything, on virtually every desk and begin to allow students to tap into the information sources that are worldwide.

I get a flavor that that's some of what's going on here. And I think some of what you are doing can be instructive to people who are trying to remold education in a shape that is more adaptive to the 21st century.

Given that as a base of comments, I would just like to hear from you. Number one, do you see it moving in that direction, and do you see a role for tapping into a system where every student becomes an individual rather than a part of a whole? We have to get rid of things like Carnegie units and all kinds of things that have driven education up until now, if we are going to make it work.

But I do think that some of what you're talking about is in the vanguard of all that.

Mr. MOHLING. If I may, I think we have a lot of things that are so in-grained in the institutions of education that it has been difficult to get rid of them. But I think we have an opportunity now, with the use of technology, that we can perhaps really do some things for the first time that we haven't been able to do in the past.

We have always talked about working with our students to make them lifelong learners. Now as we help them to use the tools for learning, rather than simply giving them a particular parcel of facts, those terms that are in the chapter to go away with for the next course, we really can help students much more, I think, looking at the processing of information, how they can get access to it, providing that access to teachers and schools through technology.

We can also support from teacher to teacher with the languages that we have, but it hasn't been as easy to communicate the abilities of students and the levels at which they have accomplished, and we can use technology to support that part of the system as well.

But I think we really have some opportunities here right now, some systems that are available, that we need to work very hard at to make better available to the teachers and to schools that we can really have not only just a K-12 education or a college education, if you will, but those same tools can be used by people every day.

In fact, in part, we must catch up a little bit in the school systems to some of the adults in our community who have learned now to become lifelong learners through the use of laptop computers and modems and various kinds of data bases. But we have not taught that in schools. We don't have the equipment to do it. We haven't the training to do that. But the opportunity is there, and we must capture that, I think, in the near future.

Mr. WALKER. I couldn't agree more. And you have brought up a fundamental point. Because every kid in our schools today will work at 11 different careers in their lifetime. So they had better have some way of developing lifetime learning, or they are going to be left in the economic lurch at some point during their lifetimes.

In my view, we ought to be using the infrastructure of the schools better than we now use it. There is no reason why the schools only have to be open from 8:00 o'clock to 4:00 o'clock. There is no reason why they couldn't run 24 hours a day and bring people in who are adults and use some of the equipment and the infrastructure of the schools in order to promote that lifetime learning.

There are lots of things we could do in education which are far different than what we have done that are more adaptive. You have hit on one of the major features.

Ms. PAYTON. I want to throw one thing in, and I think it's critical. I agree with your assessment.

The thing we run into right now and I would venture to say that the vast majority of the teachers across the Nation want to get into the mode that we could better utilize or use, learn and everything else, the technology that will help us to diagnose our students better. I understand what you are saying, their interests, send them in the area of their interests. With young kids you don't do

that. We can deal with styles and other things so that we can make sure we don't lose anybody in this mode of change.

So I think if we could get and have the time, and that's a problem with us. We don't have the time, and it gets back to kind of like the money and the staff development, the whole works. Most of the schools are out right now. There are educators, K-12 educators, who would love to spend two or three weeks just looking at the next group of fifth graders or sixth graders, so that they can actually assess, take the time and look at what they need to do next year and how they need to prepare themselves for each of these individual students, their needs or whatever.

But the time is not there. There is no money, and the emphasis is not there.

The other thing I want to point out is that when we go to the technology, when we use the technology to point out the interest level and kind of steer students in that direction, I hope we do not depend on a standardized test to dictate how and where we should send our students. Because it doesn't comp. ely give us a true picture of each of the children we work with. You have got to have lots of stuff in that. And I think through the technology, all of it, step by step, using the diagnostic approach.

Mr. WALKER. I think you make a valuable point. I am not just interested in technology for analyzing the student as I am in using the technology to allow the student to develop their interests and achieve it. If in fact you had interactive television on the desk of the student, they could literally tap into the best minds in the world in the subject area that the teacher has them moving in as a part of their individualized instructional program.

To some extent, we are doing that when we tap into sources such as NOAA and NASA and all those people and utilize them in ways that help the students learn. I am simply saying that I think we have to broaden that as a way of doing it.

I have often used the example with audiences I have talked to about the idea that I could have learned a lot more math and science in high school if you would have used the automobile as a way of getting me to learn. If you had had me analyze a Chevy 283 engine and all the ratios and so on in there, I would have learned a lot more math. Because I was going home and reading that stuff in car books anyway. It never occurred to me that what I was learning in school had some application to what I was going home and reading in car magazines.

The point being, had you tapped into that interest, I would have had far more interest in the subject matters. We weren't capable of doing that before some of the new technologies came along. Now we are. If we fail to utilize those technologies to develop the education of the future, we will have made a tremendous mistake. And we will have ill- prepared students to meet the challenges that world competition is going to impose on them, is imposing on them now, and certainly will impose on them in the future.

Mrs. MCINTYRE. One comment to what she said about the K-12 teachers wanting a job. We identified a team of five NSF Presidential awardees who were willing to sit down and write curriculum, but we don't have funding. We had an NSF grant, we were all set, but we didn't get the funding. So we cannot ask them to donate six

weeks of their time to do what is very much needed, the curriculum. The textbooks still are not caught up to date.

Mr. WALKER. You are right. That again is the problem that we may have to deal with with some technical solutions to. Because my guess is that the textbook is going to be—

Mrs. MCINTYRE. The least important.

Mr. WALKER.—the least important. It's going to be the flow of information, however that information is developed, that's going to become fundamental.

Thank you, Mr. Chairman.

Mr. HALL. You bet. Thank you, sir.

We thank this panel. You have been a very good panel. All of your testimony, every word you spoke, has been taken down and will be printed into a report to the subcommittee and the committee and will be available to the Congress. For that we thank you.

Mrs. MCINTYRE. Invite us back any time.

Mr. HALL. You bet. Any time. Keep sending Mr. Walker back to us.

Mrs. MCINTYRE. Oh, we will.

Mr. HALL. I'll be a little more kind to him on the time next time.

We have a very distinguished third panel, and we are honored that we have Representative Eleanor Holmes-Norton, who is the U.S. House of Representatives Delegate of the District of Columbia, a very valuable member of this Congressional body, and a lady that's a leader in almost everything that's worthwhile in this Congress. We are honored to have her here, and we are going to recognize her as John Haskins, Nadir Al- Salam and Dr. Rousseau come to the table.

It looks like we are going to have the benefit of being visited by some more gifted students, and we sure look forward to that. The Chair recognizes you, Ms. Norton.

Ms. NORTON. Thank you very much, Mr. Chairman.

Chairman Hall, and members of the subcommittee, I want to first thank you for your initiative in holding these important and unusual hearings and for inviting me to participate. I particularly commend you for the inclusion of these special witnesses, who will speak first-hand about the importance of investing in science and math education.

It is particularly gratifying to me as a native Washingtonian and a graduate of Dunbar High School to introduce my fellow Dunbar graduate, Dr. Eva Rousseau, who is now principal of Dunbar High School, and to introduce two outstanding Dunbar students, who are Enterprise Mission Scholars, Mr. John Haskins and Mr. Nadir Al-Salam.

Both as the District's representative and as an educator, for I am still a tenured Georgetown University law professor, and do understand my colleague's remark to the effect that what the country does not need is more lawyers, but we certainly need more scientists and more mathematicians, I am excited that Dunbar High School is the site for the Enterprise Mission pilot program.

It is particularly appropriate that the Nation's capital is able to serve as a national model for high schools around the country. Dr. Rousseau and the developers of the Enterprise Mission model understand the need for a comprehensive approach to math and sci-

ence education. The Enterprise course not only teaches abstract math and science principles, it also examines the role of science and technology in our society, and thus provides interdisciplinary academic study.

Importantly, Enterprise Mission students are committed not only to learning but also to teaching. The Enterprise Mission has a service component that allows Dunbar students to work on space and science projects with students from the Henley Elementary School in Southeast Washington. We must make sure that the Enterprise Mission has the necessary funding to be an annual credit course in any school that is willing to make a commitment, because this is precisely the kind of training that can help us produce scientists, civic and industry leaders, position and policy makers.

I congratulate and thank Dr. Rousseau, Enterprise Mission Instructor Ms. Caroline Harris, the Dunbar faculty and Dunbar students for the work they are doing to make science accessible and relevant to young people.

Mr. Chairman, I am proud to present these three outstanding Washingtonians to you today.

Mr. HALL. We certainly thank you for that. At this time, we recognize you, Dr. Rousseau. You may either narrate your choice of words or refer to your written testimony. But without objection we will put the written testimony of all three of the panelists into the record.

At this time, we recognize Dr. Rousseau.

STATEMENT OF DR. EVA ROUSSEAU, PRINCIPAL, DUNBAR SENIOR HIGH SCHOOL, WASHINGTON, D.C.

Dr. ROUSSEAU. Good afternoon, Mr. Chairman and members of the House Subcommittee on space.

With me I have two outstanding students, and the students represent a product of the program, and I think that's one of the best ways to assess a program.

With me also is Judith Richardson, who is the pre- engineering coordinator. Of course, Caroline Harris is the project director, and we have Delores Carter who is the coordinator for field experience.

Mr. HALL. Are they here?

Dr. ROUSSEAU. Yes, they are.

Mr. HALL. Would you like for them to stand?

Dr. ROUSSEAU. Would you please allow them to stand?

[Applause.]

Mr. HALL. Please proceed.

Dr. ROUSSEAU. It is a pleasure to appear before this committee to share the success that Dunbar High School's pre- engineering program has had with integrating space science and technology into a national model curriculum for a new classroom setting called the USS Dunbar. We are very proud because our space lab is the only one of its kind in any high school in the Nation.

The exploration of our solar system and space phenomenon provides our students with a unique opportunity to participate in real life, real time scientific discovery. The study of space encompasses a vast body of known and yet to be discovered knowledge.

Uncovering the mysteries of our universe, its origins and evolutionary path, involves a diverse array of domestic and international players from industry, government and academia. I am very pleased to say that there a number of businesses, organizations and agencies that have joined to form a collaborative effort to support that space lab at Dunbar High School. By looking outward into space and back to Planet Earth, students involved in the USS Dunbar program are engaging in the vital pursuit to manage earth's resources and improve our quality of life.

You mentioned earlier something about our needing to get more information in the area of health. We, too, share that concern. We are hoping that as a result of space exploration we will get some answers to help us with medical problems. Because there a number of diseases for which there is no cure, and they are plaguing our community and resulting in a number of untimely deaths.

In our 21st century classroom, and we regard it as a break the mold classroom, students study history, politics, international relations, law, physics, astronomy, biology, earth science, algebra, geometry, technology, language arts, and sociology. Without question, the space program presents educators with an ideal framework to create a new learning environment, one that can help prepare our youth for a technologically oriented work force.

The USS Dunbar classroom utilizes state of the art technologies to capture, catalog, manipulate and analyze data from a variety of sources, including data from NASA, observatories from around the world and archival information from previous space missions. The space-oriented curriculum involves students in current research and offers and interdisciplinary, integrated, problem solving, team approach to education that captures students' imaginations and directly involves them in the exciting endeavors undertaken by scientists and astronauts.

An effective space program requires the continued development of state of the art technologies and skilled, informed professionals who design, build and operate these technologies. The multidisciplinary, dynamic nature of space- oriented curriculum certainly attracts students with varied interest and talents.

It is ideal for having students work on teams to conduct analytical investigations that develop higher level cognitive learning skills. In a unique way, this new learning environment also enables students to identify their strengths and weaknesses, and it enhances their opportunities to learn from one another.

When students are challenged and find purpose and relevancy in school work, it is clear that their own level of motivation increases dramatically. Furthermore, when students feel ownership and are empowered to direct their academic pursuits, they are uniquely positioned to develop essential work force behaviors and attitudes.

The United States Space Program is providing Dunbar Senior High School students and faculty with an extraordinary learning environment, one which we hope will serve as a national model for other schools. We are also working collaboratively with the Washington Space Business Roundtable to institutionalize the program at Dunbar and expand it to other school sites, beginning the District of Columbia.

By 1994, it is our vision to replicate the program nationally in the targeted school districts. We will also continue to work closely with NASA Headquarters' Solar System Exploration Division and Goddard Space Flight Center to ensure the integrity of the curriculum and access to state of the art technologies, resources and professionals.

Let me conclude by saying that today, Dunbar students and faculty are involved in the USS Dunbar program and they are implementing a model classroom for the future, emphasizing excellence in math and science. With a focus on space, the USS Dunbar classroom is a school-based opportunity enabling students to become active participants in their educational preparation while also motivating them toward careers in science and engineering.

[The prepared statement of Dr. Rousseau follows:]

TESTIMONY OF DR. EVA R. ROUSSEAU, PRINCIPAL DUNBAR SENIOR HIGH SCHOOL, WASHINGTON, DC BEFORE THE SUBCOMMITTEE ON SPACE UNITED STATES HOUSE OF REPRESENTATIVES

Good afternoon, Mr. Chairman and members of the House Subcommittee on Space. It is a pleasure to appear before this committee to share the success Dunbar Senior High School's Pre-Engineering Program has experienced by integrating space science and technology into a national model curriculum for a new classroom setting called the USS Dunbar.

The exploration of our solar system and space phenomenon provides our students with a unique opportunity to participate in "real life", "real time" scientific discovery. The study of space encompasses a vast body of known and yet to be discovered knowledge.

Uncovering the mysteries of our universe - its origins and evolutionary path - involves a diverse array of domestic and international players from industry, government and academia. By looking outward into space and back to Planet Earth, students involved in the USS Dunbar program are engaging in the vital pursuit to manage Earth's resources and improve our quality of life.

In this 21st century classroom, students study history, politics, international relations, law, physics. astronomy, biology, earth science, algebra, geometry, technology, language arts and sociology. Without question, the space program presents educators with an ideal framework to create a new learning environment - one that can help prepare youth for a technologically-oriented workforce.

The USS Dunbar classroom utilizes state-of-the-art technologies to capture, catalogue, manipulate and analyze information from a variety of sources, including data from NASA, observatories from around the world and archival information from previous space missions. The space-oriented curriculum involves students in current research and offers an interdisciplinary, problem-solving, team approach to education that captures their imaginations and directly involves them in the exciting endeavors undertaken by scientists and engineers.

DR. ROUSSEAU TESTIMONY-PAGE TWO

An effective space program requires the continued development of state-of-the-art technologies and skilled, informed professionals who design, build and operate these technologies. The multi-disciplinary, dynamic nature of space-oriented curriculum certainly attracts students with varied interests and talents. It is ideal for having students work on teams to conduct analytical investigations that develop higher level cognitive learning skills. In a unique way, this new learning environment also enables students to identify their strengths and weaknesses, as well as learn from one another.

When students are challenged and find purpose and relevancy in school work, it is clear that their own motivation level increases dramatically. Furthermore, when students feel ownership, and are empowered to direct their academic pursuits, they are uniquely positioned to develop essential workforce behaviors and attitudes.

The United States Space Program is providing Dunbar Senior High School students and faculty with an extraordinary learning environment -- one which we hope will serve as a national model for other schools. In order to meet our immediate and future goals, I am working collaboratively with the Washington Space Business Roundtable to institutionalize the program at Dunbar and expand it to other school sites, beginning in the District of Columbia. By 1994, it is our vision to replicate the program nationally in targeted school districts. We will also continue to work closely with NASA Headquarters' Solar System Exploration Division and Goddard Space Flight Center to ensure the integrity of the curriculum and access to state-of-the-art technologies, resource materials and professionals.

Today, students and faculty involved in the USS Dunbar program are implementing a model classroom of the future, emphasizing excellence in math and science. With a focus on space, the USS Dunbar classroom is a school-based opportunity, enabling our students to become active participants in their educational preparation while also motivating students toward careers in science and engineering.

I would like to thank the Chairman and members of this committee for inviting Dunbar Senior High School to contribute to these important proceedings on the positive impact of integrating space topics into traditional academic study.

DUNBAR HIGH SCHOOL WITNESS BIOS FOR THE HOUSE SUBCOMMITTEE ON SPACE CONGRESSIONAL TESTIMONY

John W. Haskins, Jr. is a junior at Dunbar Senior High School in the Pre-Engineering Program. In 1991, he was one of a select group of Dunbar students who worked to create the USS Dunbar classroom and contributed his computer science expertise to the program's trial space missions. A member of the National Honors Society and the Math Club, John has received many national awards for his exceptional skills in the area of computer science. These awards include: second place in the NAACP Act-So Competition held in Houston, TX, first place for his team in the Black Dataprocessing Associates competition, and Distinguished Project Award for The First Annual District of Columbia Computer Science Conference. Locally, John's talents are being utilized by the District of Columbia Public Schools to develop an original computer graphics-video package which will help students prepare for the verbal portion of the SATs. He also uses his math skills to tutor his peers at Dunbar in calculus. Recently, John was featured in Computer World Magazine for a computer graphics program he designed. His career goal is to be involved in the computer graphics industry. Toward this end he hopes to attain his Ph.D. from Massachusetts Institute for Technology in Computer Science.

Dr. Eva Rousseau is the principal of Dunbar Senior High School, Washington, DC and the Superintendent's Lead Principal responsible for a school cluster of 23 elementary, junior high and high schools. Under her leadership, Dunbar Senior High School has gained a reputation for educational excellence, particularly in the areas of science and mathematics. She has worked with her staff to create an exemplary pre-engineering program, providing students with the motivation, skills, behaviors and attitudes essential for science and engineering careers.

For the past 25 years, Dr. Rousseau's educational career has been yielding innovative and successful strategies that help District of Columbia youth reach their greatest potential. These contributions have been made as a high school and junior high school teacher, counselor, assistant principal and principal.

Recognized for her educational expertise, Dr. Rousseau is frequently invited to participate in national educational forums regarding such topics as improving educational opportunities for minority students; designing technology, mathematics and science curriculum, enhancing teacher education and training and developing motivational strategies for "at risk" youth. In addition, she has held leadership positions on several education task forces and committees. Currently, she serves as Chairman of the Board of Directors for the District of Columbia Principal's Center, Principal's Representative on the Public/Private Partnership steering committee, Goal Focus Leader for America 2000, and district-wide Restructuring Schools Committee.

Dr. Rousseau is the recipient of numerous honors and awards for educational leadership. Locally, she received the Superintendent's Outstanding Officer Incentive Award for Innovative Programs and Practices and the Outstanding Principal Award from Save Our Youth America. Nationally, she received fellowships from Harvard University, IBM Corporation, the Danforth Foundation, the Rockefeller Foundation and the National Science Foundation.

An alumni of Dunbar Senior High School, Dr. Rousseau was the school's 1962 valedictorian. She earned her B.A. degree from Bennett College and M.A. in Education from The George Washington University, and Ed. D. from Nova University.

Nadir Al-Salam is a junior at Dunbar High School in the Pre-Engineering Program. He is currently First Officer of the U.S.S. Dunbar and a member of the Enterprise Mission. As first officer, Nadir is responsible for coordinating student curriculum teams, supervising class discussions and leading program briefings and presentations. Nadir is active in school organizations--a reporter for the school newspaper and a volunteer for the elementary Space Quest Program. He is a member of the NASA Mars Mission seminar at NASA headquarters. Nadir plans to be a summer intern with NASA Solar Systems Exploration Division this summer.

Mr. HALL. Very good.

Have you guys decided which one is going to talk first? Do you have your minds made up?

We first thank you and appreciate your being here. You have got to be exceptional students to have been selected, and we are proud of you and grateful to you. We want you to keep on doing what you have been doing. At this time, if you want to tell us about it, John, we recognize you for a brief statement. I think you have submitted some testimony to us, have you not?

Mr. HASKINS. Yes.

Mr. HALL. We will put that in the record. And Dr. Rousseau, yours will be in the record, and Mr. Al-Salam, yours will be in the record.

We recognize you now, John, for as much time as you want.

STATEMENT OF JOHN HASKINS, JR., STUDENT, DUNBAR SENIOR HIGH SCHOOL, WASHINGTON, D.C.

Mr. HASKINS. Good afternoon, Mr. Chairman and members of the Space Subcommittee. Today it is my honor to present to you testimony on the advantages of linking space and education. As a founding member, I will be speaking to you on behalf of members of the USS Dunbar program.

The USS Dunbar program operates under the Dunbar High School's Pre-engineering Program. This program encompasses all facets of education. For example, English and social studies help develop good communication skills. We all know that no idea is any good unless it may be effectively shared. Math and science serve to help understand the laws which govern nature and the properties and laws of celestial bodies. Finally, technology is important because it is important to keep abreast of the times, and what a waste of the times it would be to graduate and not be able to apply your knowledge to our rapidly technologically changing society.

Since space is such an attention holding topic, it provides a means of teaching the essentials of living in a way that will keep students' interest and at the same time force them to realize their full potential in all of the aforementioned subjects, especially math and science. Unlike the traditional classroom setting, students involved in the USS Dunbar program are given a real-life situation to which they may apply what they have learned. Our first mission when the USS Dunbar program began was to analyze data relayed by the Hubble Space Telescope.

My contribution to the building of the program, along with that of my peers, gives me a vested interest in the success I believe will be an important aspect for its future as it is replicated in other schools.

I would like to thank you for your time.

[The prepared statement of Mr. Haskins follows:]

TESTIMONY OF JOHN W. HASKINS, JR., STUDENT DUNBAR SENIOR HIGH SCHOOL, WASHINGTON, DC BEFORE THE SUBCOMMITTEE ON SPACE UNITED STATES HOUSE OF REPRESENTATIVES

Good afternoon, Mr. Chairman and members of the Space Subcommittee. Today, it is my honor to present to you testimony on the advantages of joining space and education. As a founding member of the USS Dunbar crew, I can relate my firsthand experience about this topic.

The USS Dunbar operates under the Dunbar Senior High School's Pre-Engineering Program. This program encompasses all facets of education. For example, English and social studies develop good communication skills -- and we all know that no idea is any good unless it can be shared effectively. Math and science serve to help understand the laws which govern nature and the properties and laws of celestial bodies. Finally, technology is critical because it keeps us abreast of the times -- what a waste it would be to graduate and not know how to apply your knowledge to the rapidly, technologically changing society.

Since space is such an attention holding topic, it provides a means of teaching the essentials of living in a way that will keep students' interests and at the same time enable them to realize their full potential, especially in math and science. Unlike the traditional classroom setting, students involved in the USS Dunbar program are given a real-life situation where they may apply what they have learned. Our first mission when the USS Dunbar program started was to examine information relayed from the Hubble Space Telescope.

My contribution to building the USS Dunbar program, along with that of my peers, gives me a vested interest in the program's success. I believe this aspect of the program will be an important aspect of the program's future success as it is replicated in other schools.

Thank you for this opportunity to share with you my experiences in the USS Dunbar Classroom.

Mr. HALL. We thank you very much.

Yes, Dr. Rousseau?

Dr. ROUSSEAU. Would it be possible for me to share some information about John so that you will know about this young man and this program?

Mr. HALL. Yes, please do. I believe his mother is in the audience, isn't she?

Dr. ROUSSEAU. His mother is here. John Haskins is a junior at Dunbar High School in the Pre-Engineering Program. In 1991, he was one of a select group of Dunbar students who worked to create the USS Dunbar classroom and he contributed his computer science expertise to the program's trial space missions. He is a member of the National Honor Society and the Math Club.

He has received many national awards for his exceptional skills in the area of computer science. These awards include second place in the NAACP Act-So Competition held in Houston Texas, first place for his team in the Black Data Processing Associates competition, and Distinguished Project Award for the First Annual District of Columbia Computer Science Conference.

Locally, John's talents are being utilized by the D.C. Public School System to develop an original computer graphics video package which will help students prepare for the verbal portion of the SAT. He also uses his math skills to tutor his peers at Dunbar in calculus. Recently, John was featured in Computer World Magazine for a computer graphics program that he designed. His career goal is to be involved in the computer graphics industry. Toward this end, he hopes to obtain his Ph.D. from the Massachusetts Institute for Technology in Computer Science.

Mr. HALL. Is that all?

[Laughter.]

Mr. HALL. Do you want to be recognized further, Dr. Rousseau? Do you want to introduce his mom?

Dr. ROUSSEAU. John, please ask your mothers to stand.

Mr. HASKINS. My mom, Mrs. Genelle Haskins.

[Applause.]

Mr. HALL. Well, I will say to John, and to Nadir, all the good testimony that you have given, John, and that you are going to give, Nadir, will not go unnoticed. You realize that it is being taken down and will be made a part of the record, and will be made a part of this subcommittee's record, ready by the entire committee, and made available to the Speaker.

All of those people really should read this testimony, because it is very, very good. It is just so reassuring to me to know that we do have youngsters like this. It is a shame that if a youngster gets in trouble with drugs or has a problem with the law he gets on the front page, and these fine young men are relegated to the 56th page of the Congressional Record. But they will flat be there, and it will be read.

Nadir, we recognize you for any statement you want to make, sir.

STATEMENT OF NADIR AL-SALAM, STUDENT, DUNBAR SENIOR HIGH SCHOOL, WASHINGTON, D.C.

Mr. AL-SALAM. My name is Nadir Al-Salam, first officer of the USS Dunbar Program.

I think that space and technology are exciting topics that should be taught in all high schools. I feel this way because the USS Dunbar class has demonstrated that students are more interested in math and science when they are challenged to apply these subjects to real world situations, like those related to our exploration of space. This kind of course study prepares students for life and careers by giving us a chance to apply our school work in a working environment.

The USS Dunbar program allows students to serve as scientists, engineers and policy-makers to make decisions and solve problems. All this helps prepare us for our future careers. By assuming these leadership roles and conducting space investigations, the USS Dunbar crew is taking control of their own education and having fun while learning about science and technology.

What makes the USS Dunbar classroom different and more interesting is that in this class math and science are not just abstract concepts. For example, we conduct space investigations supported by multi-media technology to collect and analyze data from current space missions. This year, we worked on Galileo's mission to Jupiter and Magellan's mapping of Venus. In this way, we are actively participating in current space exploration, not just studying dated information in our textbooks.

Thank you, and I would like to take this opportunity to invite the members of this committee and their staffs to visit Dunbar Senior High School's USS Dunbar Classroom.

[The prepared statement of Mr. Al-Salam follows:]

TESTIMONY OF NADIR AL-SALAM, STUDENT DUNBAR SENIOR HIGH SCHOOL, WASHINGTON, DC BEFORE THE SUBCOMMITTEE ON SPACE UNITED STATES HOUSE OF REPRESENTATIVES

My name is Nadir Al-Salam, first officer of the USS Dunbar Program. I think that space and technology are exciting topics that should be taught in all high schools. I feel this way because the USS Dunbar class has demonstrated that students are more interested in math and science when they are challenged to apply these subjects to "real world" situations, like those related to our exploration of space. This kind of course study prepares students for life and careers by giving us a chance to apply our school work in a working environment.

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Thank you, and I would like to take this opportunity to invite the members of this committee and their staffs to visit Dunbar Senior High School's USS Dunbar Classroom.

Mr. HALL. Well, I'll tell you, that would be a better junket than some of those trips to Europe and other places that some of these guys make.

[Laughter.]

Mr. HALL. It would be a lot more meaningful to us, wouldn't it, seeing what our very own right here at home can do. It think that's a good invitation, and we might take you up on it.

Ms. NORTON. Mr. Chairman, could I make an inquiry?

Mr. HALL. The Chair recognizes you for anything you want to do or say.

Ms. NORTON. Thank you. The Chairman is very kind and considerate, and obviously brilliant because of who you see he has invited here. I have had some people waiting in my office now for some time, but I could not leave before I had the opportunity to hear from these three witnesses in particular. Thus, I am going to have to ask to be excused.

But I did want to say, Mr. Chairman, particularly in light of your remarks about the difference between getting on the front page of the papers and getting in the Congressional Record, that Dunbar High School has an unusually proud tradition of having graduated some outstanding leaders in this country. The tradition dates back to the days when it was segregated, when I went to it, and when its leadership and its reputation was just as outstanding.

But the fact is that recently members of Congress may have read during this school year about an incident at Dunbar High School where there was a shooting of a student. What I am afraid of is that that unusual event in a city that has had more than its share of crime often serves to define a place instead of its excellence. What really defines Dunbar High School is what you see before you today, overwhelmingly. Students come from all around this city because this is a science and math high school. And this is indeed Dunbar High School.

So I hope that among other things, the appearance today of the principal and these students typical of the high school illustrate to the committee and hopefully to those in the body who read the record that even when an unfortunate incident is what makes its way onto the front page, what will make its way into the Congressional Record from Dunbar and from virtually every high school in this city are the accomplishments you have heard here today.

I am very proud of each and every one of you, and I am very grateful to this committee for having had these Washingtonians here today.

Mr. HALL. I think that's very well said. The Bible tells us of the 12 the Master picked. One was bad, and he's the only one most people can even name, Judas. So people are prone to remember the bad. But we certainly recognize the good, and it far overshadows the bad. There are many more incidents of caring teachers and caring principals and caring superintendents, and youngsters who respond, than there of those incidents we see in the papers.

We are thankful for that, and we are thankful for two fine, clean young minds like yours that want to right them before you rot. By golly, this committee is proud of you, and I am proud of you, and I look to see some really great things from you in the future. I am going to follow what you do. I would like for you to keep me ad-

vised, as I am chairman of this committee, and when I leave, whoever chairs this committee should be very interested in where you go and what you do. Because that tells us what's going to happen to this country.

I recognize the gentleman from Pennsylvania for any questions he may want to ask.

Interest Growth in Other Areas Due to Space Program

Mr. Walker. Thank you, Mr. Chairman.

I would join you in being very much impressed with the testimony and the articulate presentations of both the young students here. The mention was made that what you do on this is use an interdisciplinary approach, that the USS Dunbar concept allows you to bring together a lot of different subject matters utilizing space as the way to get at them.

Can either of you two, or maybe both of you, relate subject matters that you are not particularly interested in that you got interested in as a result of something that happened in this program?

Mr. Al-Salam. Before I got into the program, I wasn't really that good with my communications skills. When I entered the program, I learned how to work on the computer, and work in groups with other students, and communicate better. This program has helped me a lot.

Mr. Walker. You obviously did very well at that. You have communicated very well here today. That's something that obviously has had an impact. Very good. That's the kind of thing I think is useful.

Too often, when we are talking about things, we tend to see space as only one dimensional, and I think what you have done here is present to us a format in which space becomes multi-dimensional and affects other things. That's very useful to us. That's exactly the kind of thing we want to see.

Thank you for being with us.

Mr. Hall. I think your written statements and your testimony will answer a lot of the questions the other members of the subcommittee may have. But we may ask for the right to write to you and to you, Dr. Rousseau, if we may, about other information such as how the space program has affected you, what can be done to encourage more of your classmates to excel like you, or what benefits do you derive from participating in these programs and where you are going, things like that. Others may be interested in that and may write you, and we would ask you to do that.

We of course thank all the committee. Each of us have committee people that prepared us for this meeting, and invited you, and set up the committee room. We thank all of them. We thank you for your time and wish you good luck in the future. You guys keep on doing what you are doing, keep listening to this great lady here, and you will look back in your life sometime, everyone does, when you reach my age, particularly, I look back and think about who turned me, who do I remember. Usually it's a teacher. To some it's a minister, to some it's their mother, their dad or a cousin or someone.

But to me it was a teacher. I was a very poor student, an extremely poor student. And I finally, when I was a senior in high school, I had a teacher that evidenced to me that she believed that I could achieve, that I might someday maybe amount to something, and I am still trying, and she's still alive. I stay in touch with her.

But you will think back and thank Dr. Rousseau and others that have touched your lives.

Thank you all, thank you, Dr. Rousseau.

We are adjourned.

[Whereupon, at 4:45 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

[The prepared statement of Mr. Douglas King, President of the Challenger Center for Space Science Education follows.]

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TESTIMONY
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SUBCOMMITTEE ON SPACE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

JUNE 10, 1992

Mr. Chairman and Members of the Subcommittee, thank you for this opportunity to submit testimony on behalf of Challenger Center for Space Science Education.

In its report *In the National Interest: The Federal Government in the Reform of K-12 Math and Science Education*, the Carnegie Commission on Science, Technology and Government argues that an informed, broadly participatory and productive collaboration among community and state leaders, federal agencies, private institutions, and the technical community is an essential component for math and science education reform. Challenger Center for Space Science Education shares this belief. In its mission to inspire and prepare students for the technological demands of the future, Challenger Center works with a variety of government, private, philanthropic and educational organizations, leveraging the unique talents, expertise and resources that each can provide. Apple Computer Inc. says of Challenger Center, "It celebrates what is possible when business, educators and community groups work together for positive change. Challenger Center is a living model for education."

Founded by the families of the seven Challenger shuttle astronauts, Challenger Center is a national not-for-profit organization committed to continue the Challenger crew's educational mission. Using space exploration as a unifying theme, Challenger Center develops educational programs designed to capture participants' interest in science and technology and encourage further study in these fields, both in school and on an individual basis. Many studies reveal that it is in the elementary years that students decide they can't understand -- and then aren't interested in -- science and mathematics. Challenger Center programs are designed to increase students' enthusiasm for science and mathematics before they turn away from these subjects forever.

The primary target audience for Challenger Center educational programs is middle-school students: students who are still impressionable and eager to learn, and who have not yet made final decisions about their abilities and career options. The enormous appeal that space holds for youngsters makes it an invaluable tool for motivating them to learn, sparking their creativity and inspiring them to pursue paths to discovery and invention. Challenger Center's focus on space exploration encourages an integrated curriculum approach to science instruction. Its programs teach students that mathematics, science and technology are not abstract and isolated subjects, but interrelated disciplines that work together to bring about extraordinary results. NASA assists Challenger Center by providing expertise, materials and personnel to help accomplish the educational goals that both organizations share, as formalized in a 1988 Memorandum of Understanding.

All Challenger Center educational programs are created using a four-part instructional model which emphasizes content, cooperative learning, problem-solving and decision-making. Additionally, all programs emphasize the incorporation and encouragement of females and minorities in the sciences. Challenger Center works with renowned specialists in minority education to design programs to reach groups not traditionally represented in the sciences, and with community groups to place Challenger Learning Centers in urban, high minority communities.

The core of Challenger Center's educational offerings is its network of Challenger Learning Centers, located in museums, science centers and schools across the country. A Learning Center is an exciting, interactive facility where students and educators work in teams to solve problems in science, mathematics and technology within the context of a simulated space flight. Each Learning Center is comprised of a "Space Station," which simulates the experience of working in space, and a "Mission Control," modelled after Mission Control at NASA's Johnson Space Center. The Learning Center presents tasks and poses dilemmas to develop problem-solving, decision-making and communication skills among students inside the Space Station and Mission Control. During a two-hour mission, students work in teams to build a probe, solve oxygen shortage problems, study plant chromatography, manipulate "hazardous" materials with robots, chart flight patterns, calculate statistical probabilities of successful landing sites, and monitor the health of the crew. Unexpected problems are built into each simulated mission to be dealt with by the crews and ground controllers. Solutions to the problems depend on teamwork and the application of technology. Each simulated space mission is supported by pre- and post-visit curriculum materials for teachers to use in the classroom.

There are currently twelve Challenger Learning Centers in the United States and Canada, with an additional three scheduled to open by the end of 1992. Thirty operational Learning Centers are planned by 1995. Learning Center missions have been conducted in English, Spanish, Chinese and French, and adapted for use by physically and mentally impaired students. The success of the Challenger Learning Center network is due to the strength of the partnerships underlying it. Challenger Center acts as a catalyst for change at the local level, working with representatives from local science centers, school districts and universities to help establish a Challenger Learning Center in their community.

Challenger Center's other educational programs include teacher training workshops, an annual satellite teleconference program, and an annual classroom project, all of which are offered nationally. Challenger Center workshops show teachers how to draw on children's universal interest in space exploration to engage school classes in exciting problem-solving, communication, teamwork, and critical thinking exercises based on science, mathematics and technology. The workshops demonstrate dramatic and effective learning approaches and provide teachers with classroom activities and curriculum materials that enhance science and mathematics lessons and motivate students to stay with these courses. Presenting the workshops are Challenger Center's International Faculty -- a group of master teachers which includes many of the state and agency finalists in NASA's Teacher-in-Space Project. Barbara Morgan, NASA's Teacher-in-Space designee, is an active member of the International Faculty and a member of Challenger Center's Board of Directors.

Challenger Center hosts an annual satellite teleconference program broadcast live to classrooms across the country, featuring space-based lessons, "call-in" interviews, and activities and materials for in-class use. The 1990 teleconference, "Return to the Moon," was hosted by Dr. Lynn Bondurant of NASA; his guest was Michael Collins, pilot of the command module Columbia for the flight of Apollo 11. The 1991 Challenger Center teleconference, "Suited for Space," was broadcast to more than 1,000,000 students and teachers. Dr. Kathryn Sullivan, the first American woman to walk in space, and Colonel Fred Gregory, commander of the Space Shuttle Mission 51-B, were featured guests.

Challenger Center also offers a series of classroom project activities and curricula involving students from around the country in year-long space missions designed to address the challenges of problem-solving in multicultural and multilingual situations. The series premiered this year with "Marsville - the Cosmic Village," endorsed as one of the lead educational projects for International Space Year by the 26-nation Space Agency Forum for International Space Year (SAFISY) at its meeting in Kyoto, Japan, in May 1990. The purpose of Marsville is to create for young people a positive vision of the technological society of the twenty-first

century and their role in making it a reality. While the primary educational thrust in Marsville is science, math, technology and communications, the project uses a cross-curricular, holistic approach integrating the humanities (arts, language, music) as well as the social and political sciences. Examining and learning from the historical experience of their home planet's development, students are asked to create a new human world, a multi-national settlement on Mars. In effect, students are asked to become pioneers of the space frontier.

Challenger Center's educational programs have reached more than 1.5 million students and 50,000 teachers nationwide. The twelve operational Challenger Learning Centers reach more than 200,000 middle-school students annually, of whom 50% are female and approximately 35% are minorities. Non-school participants in Learning Center programs number more than 15,000 annually.

Early evaluations of Challenger Center programs indicate that they are having a positive impact on student and teacher participants. An independent evaluation of the Challenger Learning Center experience conducted by the University of Dayton found that

- two-thirds of the students reported that they had learned something scientific;
- more than two-thirds of the students responded with statements of improved self-esteem and self-knowledge;
- almost half of the females interviewed responded with a more positive judgement or feeling of efficacy about doing something technical or scientific, while 71% stated they "liked science" as a result of the Learning Center experience;
- almost one-half the students said they learned the importance of teamwork and effective communication from the experience;
- 99% of the participants indicated a desire to return to the Learning Center, saying it was a "fun" experience; and
- all teachers participating in the study reported their students more willing to work in teams, and rated the experience high in problem-solving, creativity and communication.

A longitudinal study of the impact of all Challenger Center educational programs is underway in conjunction with a Department of Education Eisenhower Grant.

This year, as we commemorate the 500th anniversary of Columbus' voyage to the New World, we see all that has been accomplished in the spirit of exploration and yet know there is so much more that awaits discovery. As H. G. Wells wrote:

> For man there is no rest and no ending. He must go on, conquest beyond conquest: this little planet, and its winds and ways, and all the laws of mind and matter that restrain him; then the planets above him; and at last out across the immensity to the stars. And when he has conquered all of the depths of space and all of the mysteries of time, still he will be but beginning.

Educational institutions, the federal government, corporations, foundations and thousands of individual contributors all participated significantly in Challenger Center's creation, and they continue to support its mission today. The Challenger Center mission is an ambitious one, yet the dream of reaching millions of students and teachers first envisioned by its founding families is rapidly becoming reality. With continued assistance and partnership from every sector, Challenger Center will continue to develop inspiring teaching and learning experiences for students into the 21st century and beyond.

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